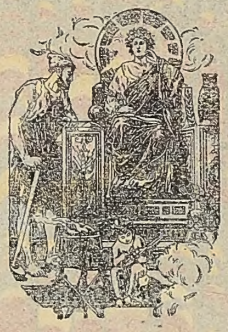
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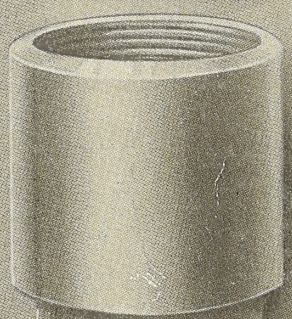
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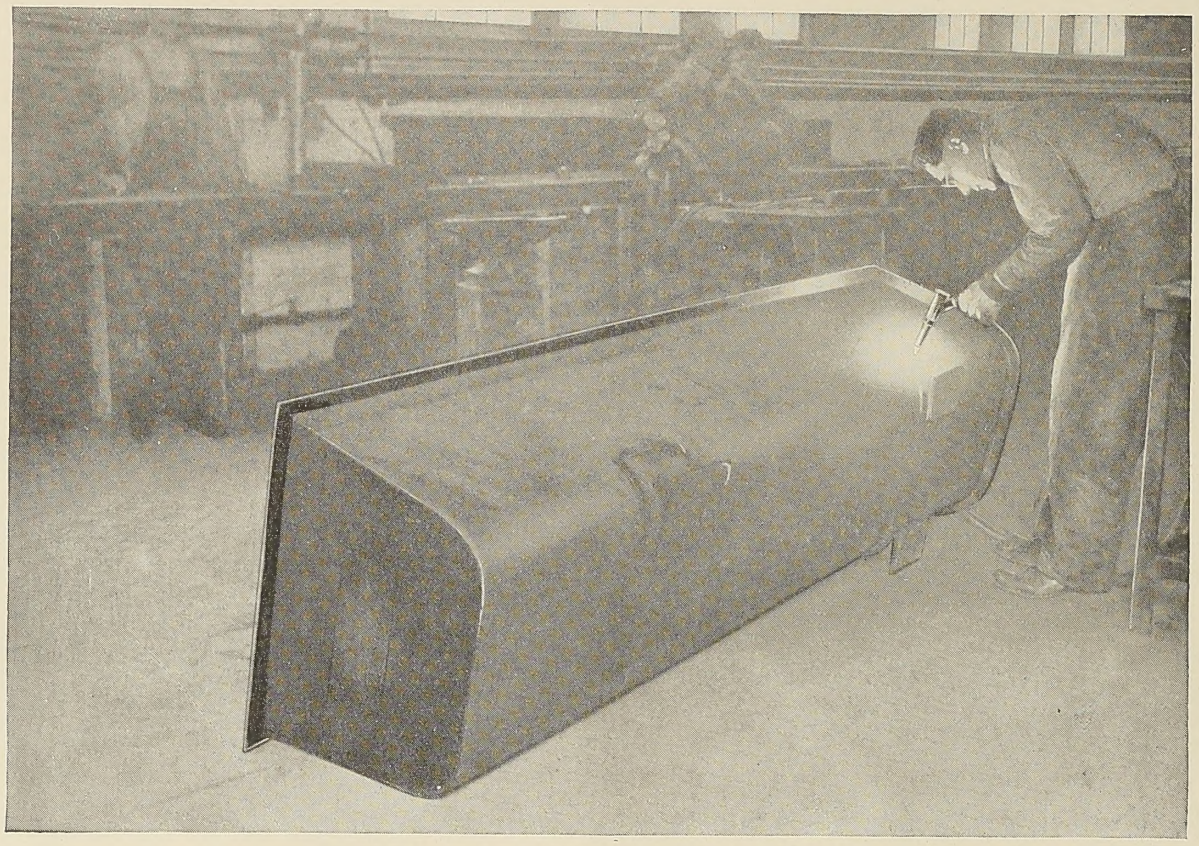
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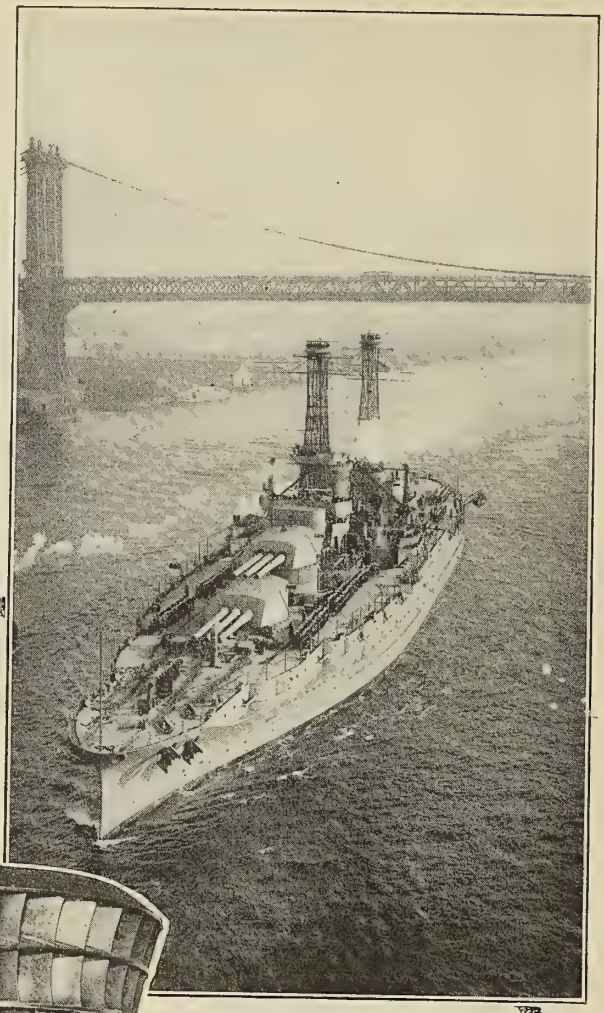
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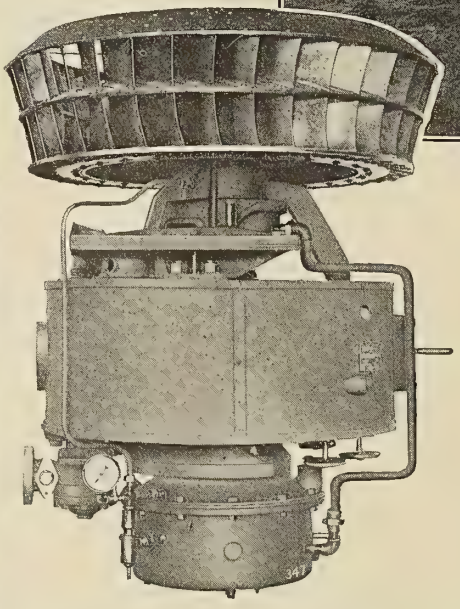
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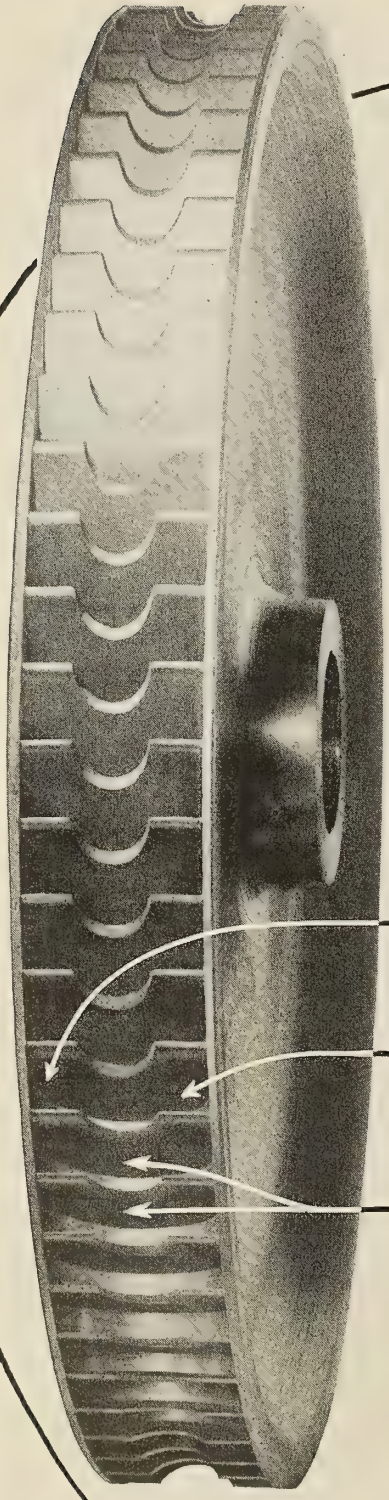


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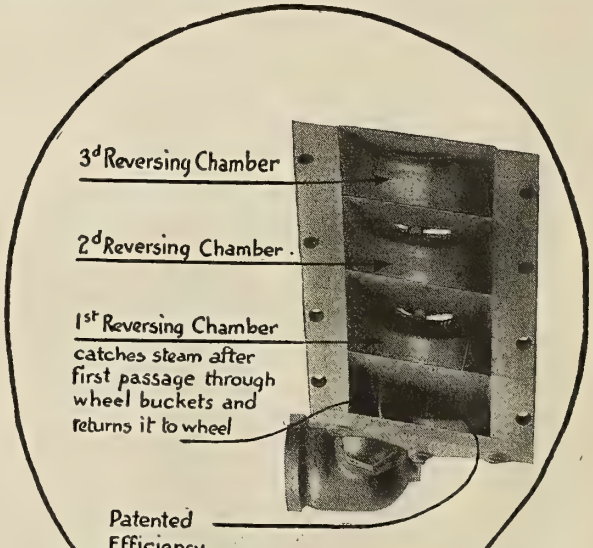
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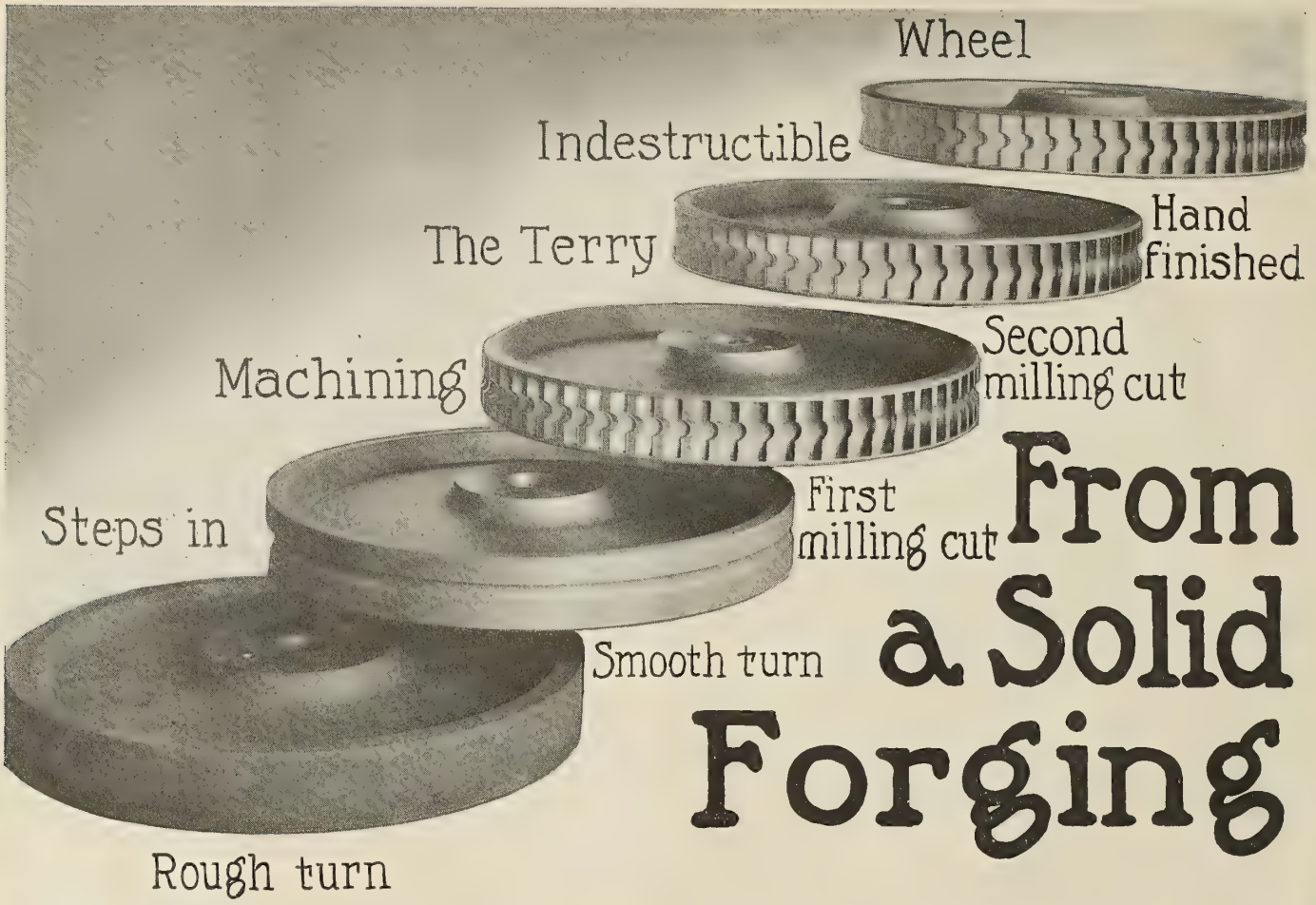
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The above illustration unretouched shows the rotor in

THE TERRY TURBINE

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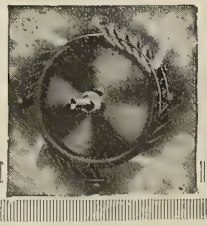
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INTERNATIONAL

Marine Engineering

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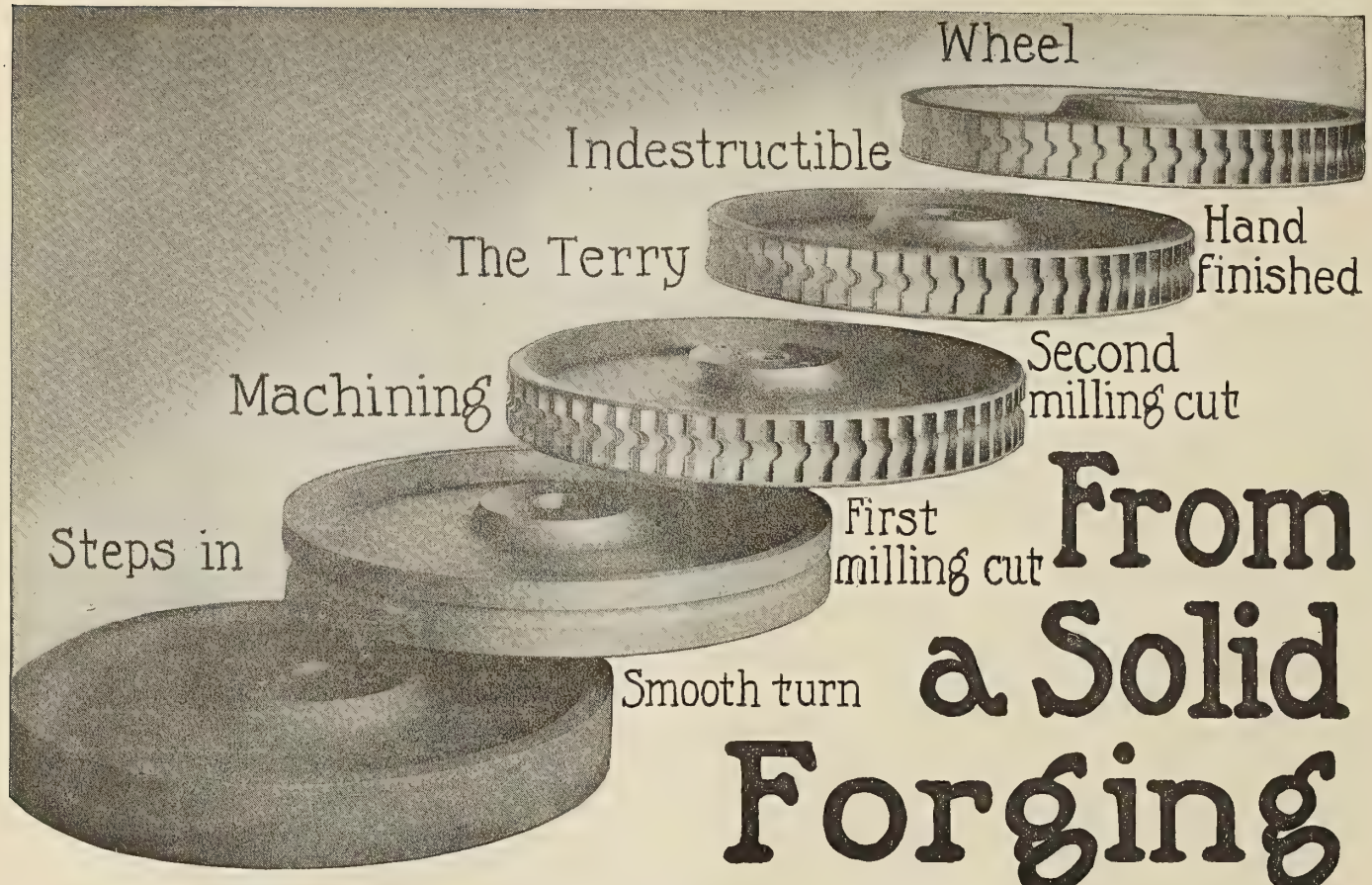
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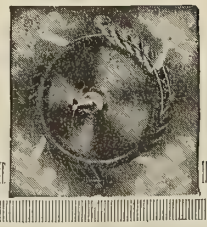
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JUL 1919

Giant Strides in Ship Production

THE report of J. L. Ackerson, vice-president of the United States Shipping Board Emergency Fleet Corporation, of deliveries, launchings and keel laying of all classes of ships for April and May, 1919, shows that the shipyards of the country are making giant strides in ship production.

In April there was a total delivery of 111 ships aggregating 368,476 gross tons, or 543,720 deadweight tons. In April, 1918, the total delivery was 31 ships aggregating 114,274 gross tons, or 171,413 deadweight tons. In May of this year the total delivery jumped to 136 ships of 511,014 gross tons, or 768,025 deadweight tons, as against 43 ships of 169,608 gross tons, or 254,413 deadweight tons, last May.

Launchings also made a high mark of progress in the shipyards. In April, 1919, 118 ships of 390,942 gross tons, or 586,266 deadweight tons, were sent down the ways. In April, 1918, 46 ships of 150,152 gross tons, or 225,230 deadweight tons, were put overboard. In May of this year 137 ships of 470,634 gross tons, or 705,958 deadweight tons, took the water as against 74 ships of 243,502 gross tons, or 365,255 deadweight tons, in the same month last year.

The report shows that contract steel ships constituted the great bulk of launchings and deliveries for April and May, whereas in the corresponding months of last year the deliveries were almost exclusively of requisitioned steel ships and the launchings were chiefly of requisitioned steel ships and contract wood ships.

Reinstatement of Shipbuilding Contracts

SHIPBUILDERS throughout the country, and particularly on the Pacific Coast, have been suffering from the cancellation or suspension of contracts by the Emergency Fleet Corporation and from the uncertainty which surrounds the future policy of the Government regarding the merchant marine. Naturally, shipowners and others who might be inclined to purchase ships or order them built at this time are hesitating until they can find out what the attitude of Congress will be toward the Government shipbuilding programme.

At present the combined cancellations and suspensions of shipbuilding contracts amount to 2,500,000 tons. On the Pacific Coast, where 52 percent of the merchant shipping was produced during the war, and where the shipyards have been heavily hit by cancellations or suspensions, the shipbuilders are asking the Government merely to continue in operation enough work for a reasonable time to enable the yards to get on their feet in private enterprise. Most of the shipbuilders apparently are ready to take new contracts at from $30 (6/5/0) to $35 (7/5/10) less per ton, if the amortization on cancelled contracts is taken care of. With profits of only 4½ or 5 percent or less on Government work, which is said to be an average figure for a Pacific Coast shipbuilder, some of the yards obviously will have difficulty in continuing operations in the face of cancellations of Government contracts and the lack of orders from private interests while waiting for the Government to decide its shipping policy.

Some encouragement, however, may be found in the attitude of the Senate Committee on Commerce, which will probably go on record as favoring the reinstatement by the Shipping Board of a sufficient number of suspended contracts to tide the private shipyards over the period of readjustment. J. H. Rosseter, head of the division of operations of the Shipping Board, has also indicated that reinstatement of suspended contracts is contemplated within a month or so where there are vacant ways. Probably thirty vessels, ranging from 8,400 to 11,300 tons, will soon be reinstated. In fact, it is understood that the Shipping Board will reinstate contracts to the extent of its funds in so far as vessels of large size are concerned, although all contracts for vessels of small tonnage will be cancelled. As a condition incident to the reinstatement of contracts, shipbuilders will be expected to reduce headway in their yards and also prices.

Superheated Steam

HIGH-PRESSURE, high-temperature steam, having a considerable degree of superheat, is thermodynamically of great efficiency in reciprocating engines and turbines. Land practice has borne out this theory, and the efficiency of well-designed engines has been increased from eight to twelve percent. Marine engineers and shipbuilders in this country, however, have as yet made little attempt to utilize this method of increasing the power of an installation, while other countries in doing so have realized an increase as great as fifteen or twenty percent. England, France, Japan and other foreign powers have used superheated steam to a considerable extent on the latest of their fast naval craft, as well as on merchant vessels.

The British torpedo-boat destroyer *Turquoise*, which recently completed her official trials, holds the world's record for speed by attaining an average of 39.6 knots for a four-hours' continuous run on the Clyde river course. The *Turquoise* type vessels, several of which gave remarkable service during the war, are all equipped to use superheated steam in their turbines, and their efficiency by its use has been increased between ten and fifteen percent. Steam is supplied in these cases at 265 pounds pressure and about 150 degrees superheat, which is a quality of steam quite easily attained at this pressure. As the pressure required in an installation is reduced, superheating is more easily accomplished and in all cases will give a marked increase in the efficiency.

At a time like the present, when every economy of

operation must be practiced in order to enable American vessels to compete successfully with foreign shipping, the use of superheated steam in merchant vessels should be more generally adopted.

Women as Naval Architects

BY voting at its last meeting to admit persons from both sexes to membership, the Institution of Naval Architects has sanctioned a custom that is new to professional organizations in the marine field. After a referendum submitted to the members of the Institution regarding this matter, which resulted in a favorable vote, the council recommended an alteration of the by-laws of the Institution so that women could be admitted to membership. The motion to this effect, proposed by Sir William Smith and seconded by Sir Alfred Yarrow, was carried unanimously. Subsequently Miss E. M. Keary, of the National Physical Laboratory, who has already collaborated with one of the members in presenting a paper before the Institution, Miss R. M. Parsons, daughter of Sir Charles Parsons, and Miss B. E. Thornycroft, daughter of Sir John Thornycroft, were elected associates of the Institution, subject to the sanction of the council to the alteration of the rules.

The North-East Coast Institution of Engineers and Shipbuilders has also decided to admit women to membership, and the first lady to be admitted, Lady Parsons, is to be made an honorary fellow of the Institution at the meeting to be held in Newcastle this month.

The Still Engine

AN economy of fuel consumption at least 20 percent above that of any other type of prime mover is claimed for a new type of engine developed by William Joseph Still, a British inventor. The results obtained with various types of the engine using gas, gasoline (petrol) or heavy oil were presented recently in a paper read before the Royal Society of Arts in London by Frank E. D. Acland, member of the Institution of Civil Engineers.

The underlying principle of the system on which this engine operates consists in raising steam from the heat ordinarily lost in the cooling water and exhaust of internal combustion engines. Hitherto such steam as has been recovered from these sources has been used in external engines subject to all their negative work in accelerating and retarding the moving parts and to losses from radiation, friction and condensation. In the Still engine the steam generated by the heat from the cooling water and exhaust gases is expanded in the internal combustion engine itself at the back of the main piston, one stroke being performed by the steam pressure and the other by the combustion pressure. In this way it is claimed there is no loss by condensation, as the steam picks up heat during its expansion stroke from the surfaces of the combustion cylinder, which are of necessity at a higher temperature than the steam itself.

How great the opportunities are for improving the efficiency of a prime mover by recovering the heat energy in the fuel ordinarily wasted is, of course, well known. In the steam engine this amounts to about 80 percent, and in the internal combustion engine to from 60 to 75 percent. In the case of the internal combustion engine, however, these losses are capable of reduction and, to a considerable extent, of recovery. This is what the Still engine is designed to accomplish, and, according to the results given in the paper, an increase in fuel efficiency of at least 20 percent has been attained.

In the application of the Still engine to commercial marine work, the two-stroke single-piston type, in powers of 100 and 400 horsepower per cylinder, is being adopted. Engines of this type at 120 revolutions per minute, with a cylinder 22 inches in diameter by 36 inches stroke, giving 4,200 shaft horsepower on two shafts, with all auxiliaries and water, would approximate about 600 tons. It is pointed out that a geared turbine plant in a similar ship would weigh 20 percent more and would consume approximately 2,000 tons more fuel for a double voyage lasting 1,000 hours.

Improved Terminals

WE take the liberty of quoting as follows from a private letter:

"If the shippers and importers of this country, looking forward to successful competition with European countries in export trade, had any conception of the almost criminal inefficiency of freight movement at ports and to what a great extent they were to blame, and with what enthusiasm shipowners and terminal operators would welcome their co-operation in modernizing American marine freight terminals, Americans could look at such European ports as that of Hamburg without blushing and American sea supremacy would no longer be a question of seamen's wages."

For years MARINE ENGINEERING has been hammering at the subject of proper mechanical equipment at marine terminals. As we have often stated, there is a potential saving of approximately fifty million dollars a year in the handling of freight at these terminals. For some reason many important men connected with steamship and steamboat companies do not seem to appreciate the great importance of efficient freight-handling machinery, and yet, as the writer from whom we quote intimates, the question of proper terminals is more important than that of seamen's wages.

Vessel Salvage

YEARS ago salvage operations were directed to recovering the cargo from sunken vessels, and not the vessels themselves. Now the submerged ships constitute the "buried treasure," and it is in this direction that all the salvage companies are likely to be working at high pressure for many months to come. As everyone knows, the war has taken a very heavy toll of the world's shipping, but probably few people visualize the scene that would be presented to the eye if they could explore the bottom of the ocean for miles round many a coast-line.

Round the coast of Great Britain, for example, the seabeds are thickly strewn with wrecks, the North Sea being literally covered with vessels that can never be raised, owing to the great depth at which they are sunk. Round the Scilly Isles half a dozen vessels have been lying at a time, waiting for the attention of salvers; while all around the Mediterranean sunken craft are numerous. Round other more distant coasts the casualties have been as heavy, scores of ships lying sunk off the Murman coast alone.

The history of the British Admiralty's Salvage Section is but another example of the resourcefulness and adaptability of the naval authorities in the ever-changing developments of the war.

The Salvage Section was originally intended to look after craft casualties in the fleet, but with the rapid development of the submarine warfare it soon became apparent that merchant vessels were equally important, and the Admiralty accordingly extended the operations of the

section to all classes of sunken craft. Unceasingly throughout the war the salvers have been employed in their work of supreme usefulness, and have run up a grand total of nearly 500 vessels salved, representing about $195,000,000 (£40,000,000) worth of craft. In every case the ships, after the necessary repairs, were used again. In several instances a vessel was torpedoed a second time, and sunk, and a second time was raised by the Salvage Section and sent upon its ocean journeys.

The method of raising the submerged vessels is exceedingly ingenious. Two barges, or lifting craft, raise the sunken vessel by means of a wire cradle. The damaged ship is then towed into shallow water.

The Admiralty is putting its own section out of action in order that it may not compete with private enterprise, of which there is likely to be no lack in the future.

Control of Cooling in Castings

FOR preventing the difficulties and defects that arise from the uneven contraction of irregular masses of metal after casting, Mr. Cecil Greenhill, of Gloucester, has patented a method which depends on the application of electrical heat to the thinner and less dense parts of the castings, with the object of keeping the falling temperatures the same as those of the thicker and denser parts. As the method of application, he suggests casting runners or ribs on the thinnest sections and applying heat electrically by dropping electrodes into the molten metal and allowing the preliminary cooling to 1,300 degrees C. to make the joint.

In cooling, the thinner sections cool more rapidly than the thicker ones, but if an electrical current is passed through, more heat will be developed in the thinner ones because they have greater electrical resistance than the thicker ones. The amount of current required would not be so large as might appear at first sight, since only losses of heat have to be replaced. It would therefore not be anything like so great as would be required to heat bodies of metal up to the temperatures at which they are treated, and it would be designed merely to keep the thinnest portions at the same falling temperatures as the thickest ones.

The method of procedure might be varied so that the current might be used either through the whole range of temperature in cooling or through portions only. In the case of steel, it need perhaps be applied only at the critical periods of steel formation, say between 1,300 and 1,050 degrees C., after which the casting might be cooled naturally without harm; or the casting might be kept at 1,050 degrees, and, in shapes where the mold could be stripped, the mold might be removed and the casting placed in the annealing furnace, thus saving reheating to this temperature for annealing.

LETTERS TO THE EDITOR

The Steering of Ships

The editorial on "The Steering of Ships," which was published in the March issue of MARINE ENGINEERING, is a very clear analysis of what takes place when helm is given to a ship.

The area of a rudder is usually taken as a percentage of the *immersed* longitudinal plane of the vessel for which it is intended. This percentage is determined more or less empirically.

If too small a rudder area exists for a given vessel fitted with steam steering gear, it is scarcely noticeable, as the angle of helm is increased until the desired turning effort is obtained and vice versa.

The dimensions of rudders and parts are determined either by empirical formulæ or the classification tables. However, in view of the present status of the steering problem, some definite standards for maneuvering power should be determined for the various classes of ships. This may be given as the tactical diameter in terms of the ship's length.

Brooklyn, N. Y. CARL E. PETERSEN.

What Is the Matter With the Society of Naval Architects and Marine Engineers?

There has never been a time during the past half century when there has been such a need for the people most experienced in shipbuilding and ship operating to devote their best thought to the subject of building up the American merchant marine as there is today.

There is a Society of Naval Architects and Marine Engineers, which undoubtedly has most of these men as members, and yet with all the conferences and meetings that have been held on the subject of building up the merchant marine we hear no mention made of this society—nor is the society officially, nor any officers representing the society, called upon to give advice and the benefit of their experiences and judgment.

Isn't the society showing too much high-brow dignity and too little real, practical usefulness? It gets its name in the papers for three days at the latter part of November by having an annual meeting and a banquet, at which a lot of highsounding phrases are let loose, but when it comes to practical and useful effort the society is not heard from.

In looking over the names of the members of the council, I notice that there are a number of men who never attend the meetings, and do not even attend the banquet. Why are such men continued on the council when they show no interest whatever in the society?

The council also contains the names of a number of men who have nothing whatever to do with building ships, repairing ships or operating ships.

Isn't it about time that the society be put on a useful basis? Ought there not be a committee of some kind always ready to take any action that will help the best interests of the American merchant marine? There is no reason why such a great society as this is (or ought to be) should go to sleep the latter part of November and stay asleep until the next annual meeting is held 362 days later. Other technical societies are waking up to the needs of the fields which they represent, and several of them are doing splendid work. The Society of Naval Architects and Marine Engineers ought to wake up and stay awake. It should get rid of all men on the council who are not actively engaged in marine work, and it should have a committee always ready to be of any help possible in building up our merchant marine.

Cannot something be done to arouse the society to these needs, so that it can take an active part in restoring the merchant marine, not only in volume of tonnage but in quality of ships? If the society cannot prove that it is really worth something, it might just as well "close up shop" and go out of existence. It has been of little value in the past, and has not shown any inclination to wake up under present conditions. Let's have a real society or none!

A MEMBER.



Fig. 1.—East Side of Plant, Showing Plate and Angle Storage, Pickling Tanks and Cranes, Plate and Angle Shop, Assembly Shop and Building Slips

The Victory Destroyer Plant at Squantum

Fifteen Million Dollar Plant Erected by the Government for Building Destroyers—Operated by the Bethlehem Shipbuilding Corporation

WHEN the United States entered the war it was apparent that the greatest possible activity of its shipyards was utterly unable to cope with the situation. The merchantship loss of tonnage had to be made up if it were possible. Warship construction had to be pushed to the utmost. Hence the absolute necessity for new shipbuilding plants. The insistent call for destroyers in large numbers was answered by the building of the big Victory Plant at Squantum, Mass.

Monks & Johnson, Boston architects and engineers, were commissioned by the Government to design and supervise the construction of this large undertaking—the $15,00,000 (£3,075,000) destroyer plant. The main plant, located at Squantum, Mass., is not merely for fitting out hulls; it turns out finished destroyers from raw materials and those accessories and fittings which can be obtained elsewhere. Auxiliary or tributary plants are located at Tonawanda, N. Y., and Providence, R. I. In these plants, which are Government-controlled and owned, but operated by the Bethlehem Shipbuilding Corporation, are built the turbines and boilers which are shipped to the main plant at Squantum.

Scope of the Plant

Practically every kind of metal-working shop and warehouse had to be provided, except a foundry. To make a complete, efficient plant out of these buildings for fabricating metal and assembling the parts necessitated also auxiliary buildings and features, such as an administration building, powerhouse, internal transportation, bridges and roads, sewer system, wash rooms, restaurants, etc.

The plan (Fig. 4) shows clearly the location and arrangement of these buildings. It also shows the waterfront and the connection to steam railroads and street-railway lines leading to Boston, about six miles away. Appliances and apparatus for the conservation of labor are everywhere noticeable. This modern plant is laid out to handle all material and apparatus with the least possible lost motion and loss of time The movement of material through its various stages of fabrication follows the most direct path they can bring it, with the fittings, to the assembly. Provision is made for convenient storage of such parts as may be completed before required in the building slips, so that every step may proceed in an orderly manner with nothing to block progress or slow up construction.

Rapid Construction the Main Object

Careful planning and study were absolutely necessary, yet time was all-important. Fortunately, the Monks & Johnson organization included men who not only knew just what was needed, but worked so well with the Government that in an incredibly short time the plans and specifications were ready for the contractors. Standard constructions were adopted and apparatus which could be quickly obtained were specified. In short, the engineering was directed toward rapid construction, because the activity of the German submarine forcibly pointed to the urgency of destroyed construction. This shipbuilding plant is unique in that bad weather causes no delay, for every operation is carried on under cover.



Fig. 2.—General Machine Shop, Electrical Shop and Carpenter Shop

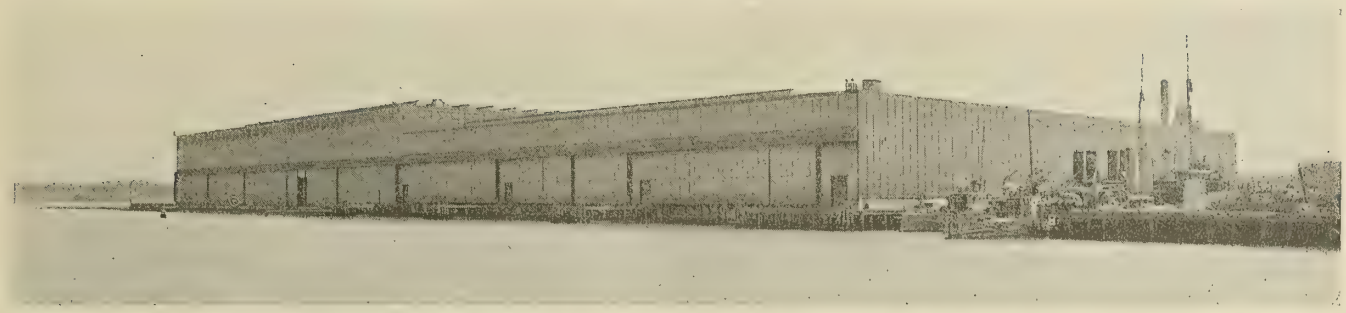


Fig. 3.—North End of Building Slips, Wet Slips and Open Dock

To get a working notion of this plant, one must glide over many of the usual but necessary details, paying most attention to the general plan and the factors which make rapid, systematic construction possible. While the warehouse and storage places are ample and equipped with electric cranes, industrial tracks, etc., it is the building slips and fitting-out docks that excite the real interest. Storage yards for plates and angles, the plate and angle shop, the frame and bulkhead assembly, are described by their names.

Building Slips

Just beyond the frame and bulkhead assembly and between it and the building slips is the finished storage. This part of the plant is served by two lines of overhead cranes, running parallel to the waterfront. Plates and angles as they come finished from the plate and angle shop are brought to this finished storage on narrow-gage flat cars that are sorted and stored by the overhead cranes at the head of the building slip in which they are to be used.

Each building slip, of which there are ten, has two overhead crane runways extending the entire length of the ship across the finished storage and one bay into the assembly space. As these runways are much higher than the cranes in the assembly space the finished frames and bulkheads can be picked up by the building slip cranes and placed in their proper places in the ship. The building slips have inclined flooring on which the ships are

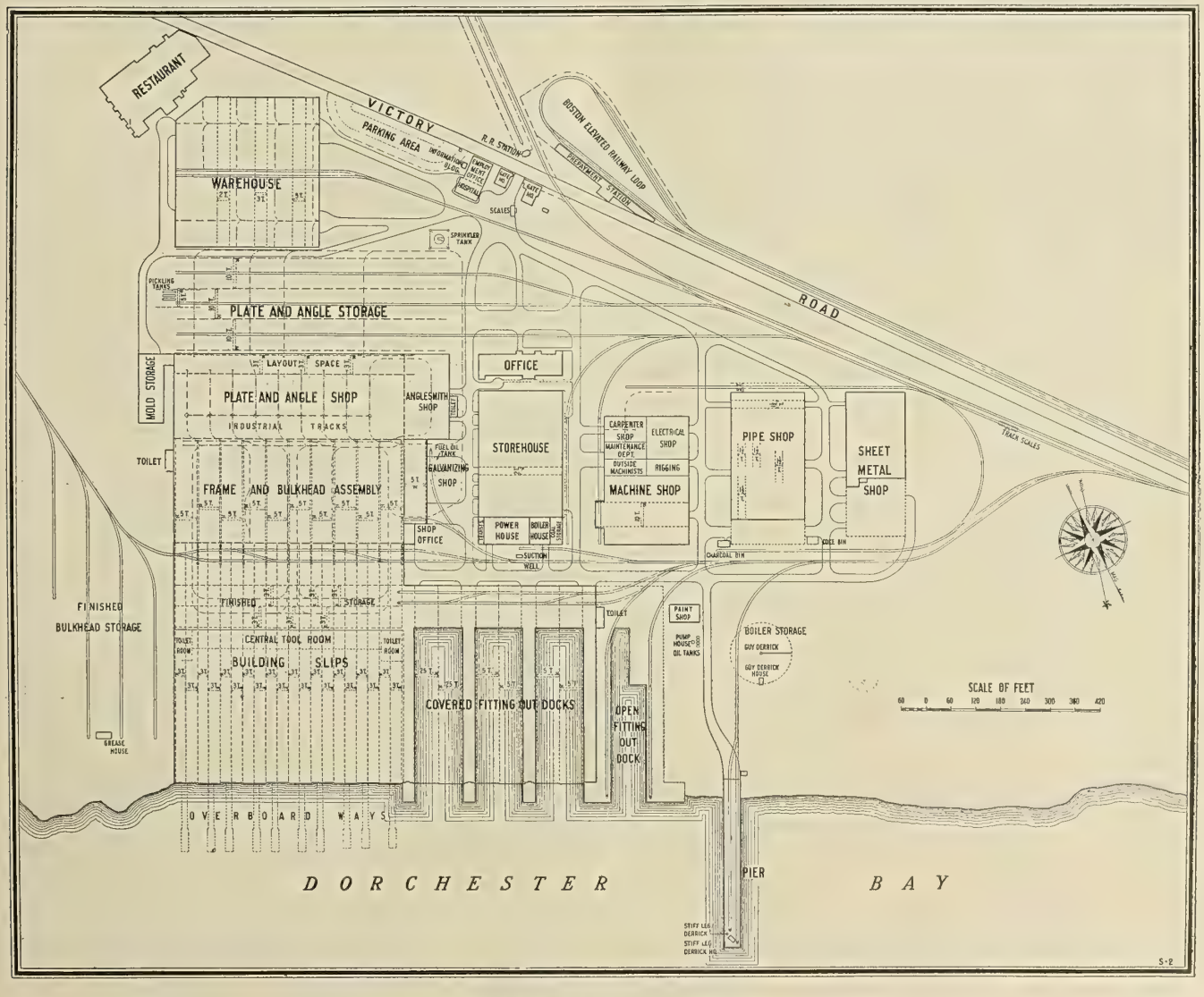


Fig. 4.—Plan of Squantum Plant



Fig. 5.—Sheet Metal Shops

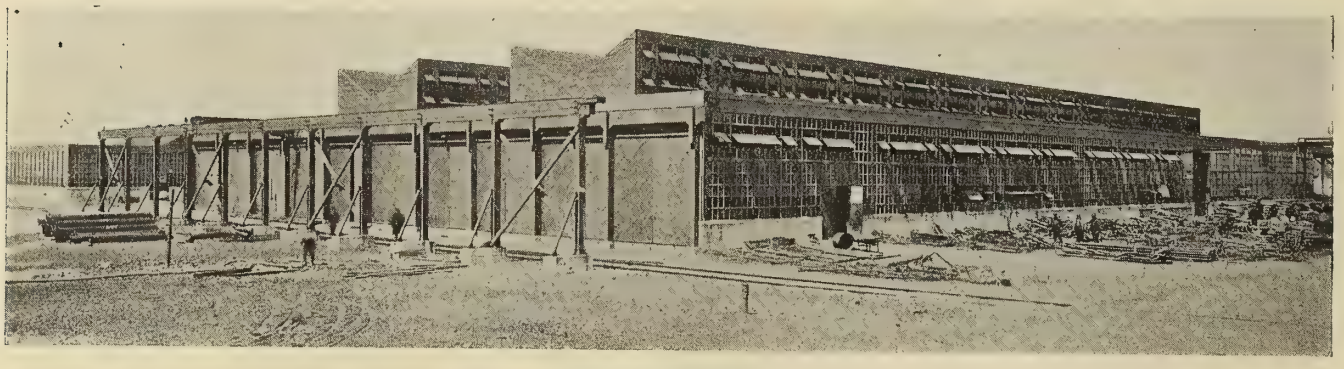


Fig. 6.—Pipe Shop



Fig. 7.—Administration Building

built. The inner end of this flooring is about 16 feet above the general level, and this space provides ample headroom for the toolroom. This central toolroom is a convenient location for storing all the air and electric drills, reamers, and other small tools used in the building of slips. It also provides for a department for repairing and sharpening cutting tools.

Fitting-out Docks

Just west of the building slips are the fitting-out docks, which are also covered, and which are provided with sliding doors on the waterfront end. These fitting-out docks accommodate six destroyers. There is a crane over each destroyer, two of the cranes being of 25 tons capacity for handling boilers, engines, and other heavy parts, and the other four are of 5 tons capacity. The fitting-out docks receive material from the galvanizing shop and the general machine shop in which such machine work is done as cannot be done in an outside plant. The general arrangement of departments thus brings together the materials and the equipment so that the ships are nearly complete in the fitting-out docks.

Next to the fitting-out docks is an open dock which will accommodate two destroyers. Here the masts are put in place, and the complete destroyer is given a dock trial. This completes the sequence of construction of the destroyers, but there are some other features of this plant worthy of attention. West of the open dock is a pier

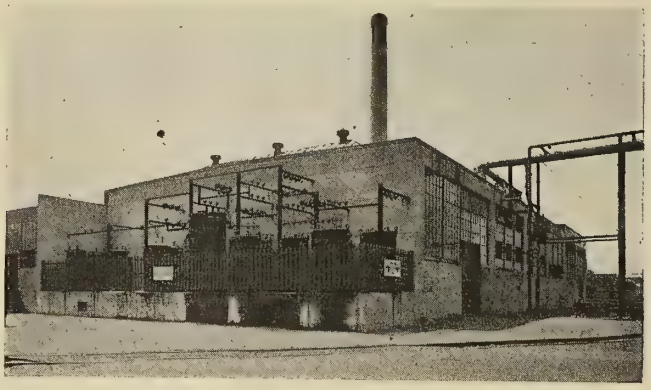


Fig. 8.—Power and Boiler House

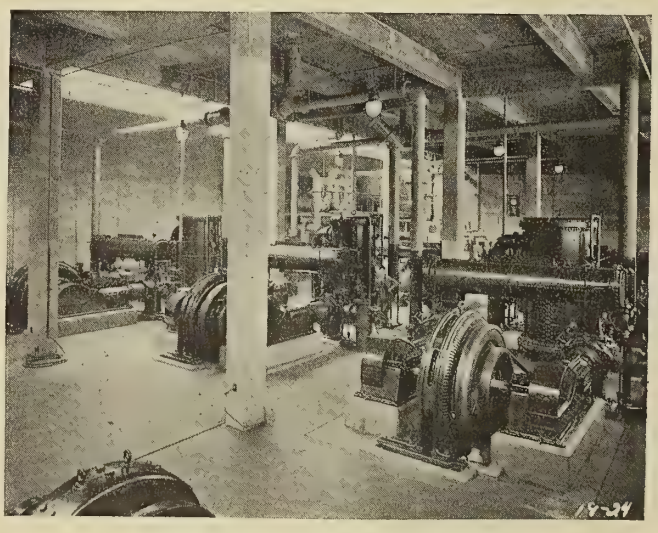


Fig. 9.—Interior of Power House

fitted with derricks and used primarily for unloading boilers and other apparatus which come by water. The boilers are stored in a space at the head of the pier.

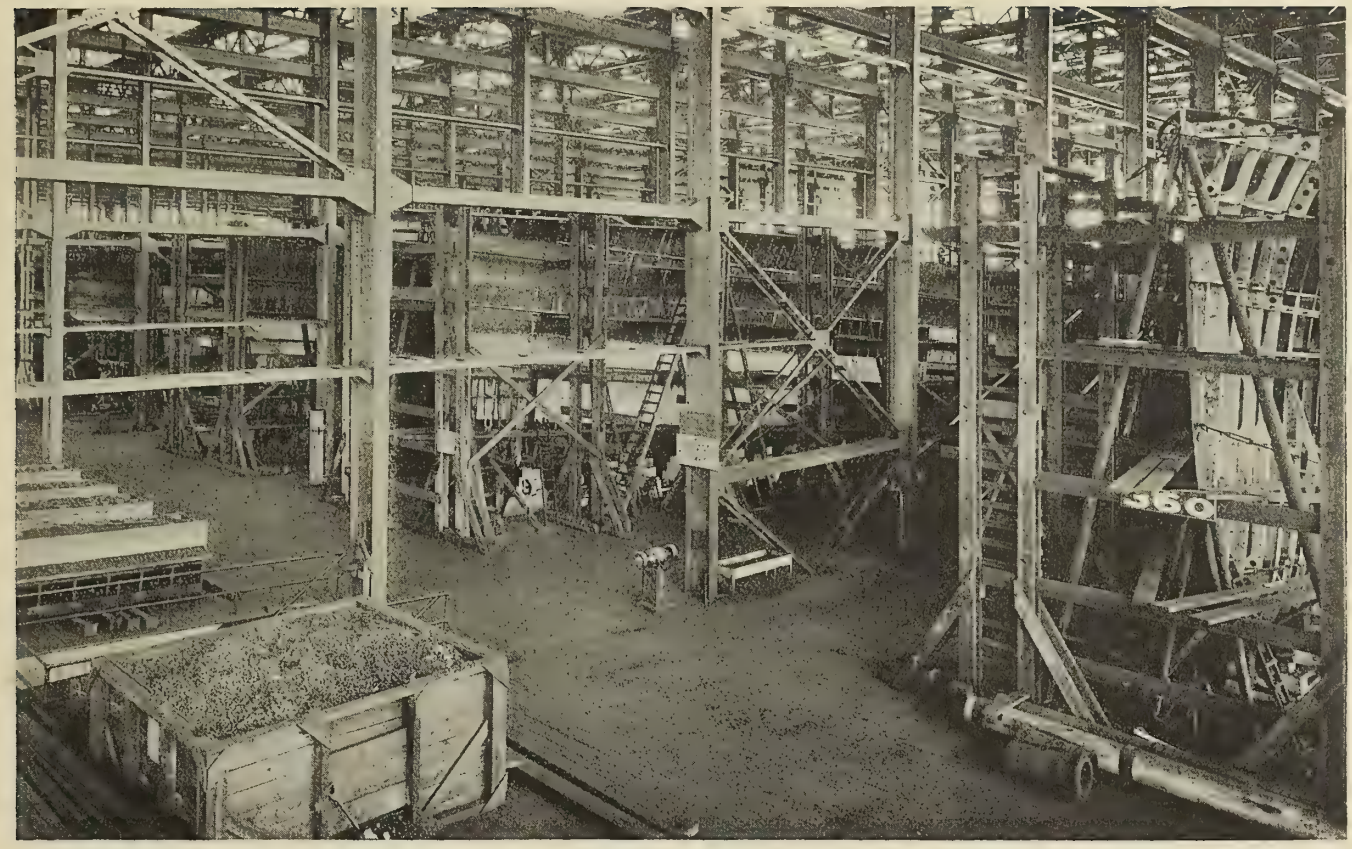


Fig. 10.—Head of Building Slips

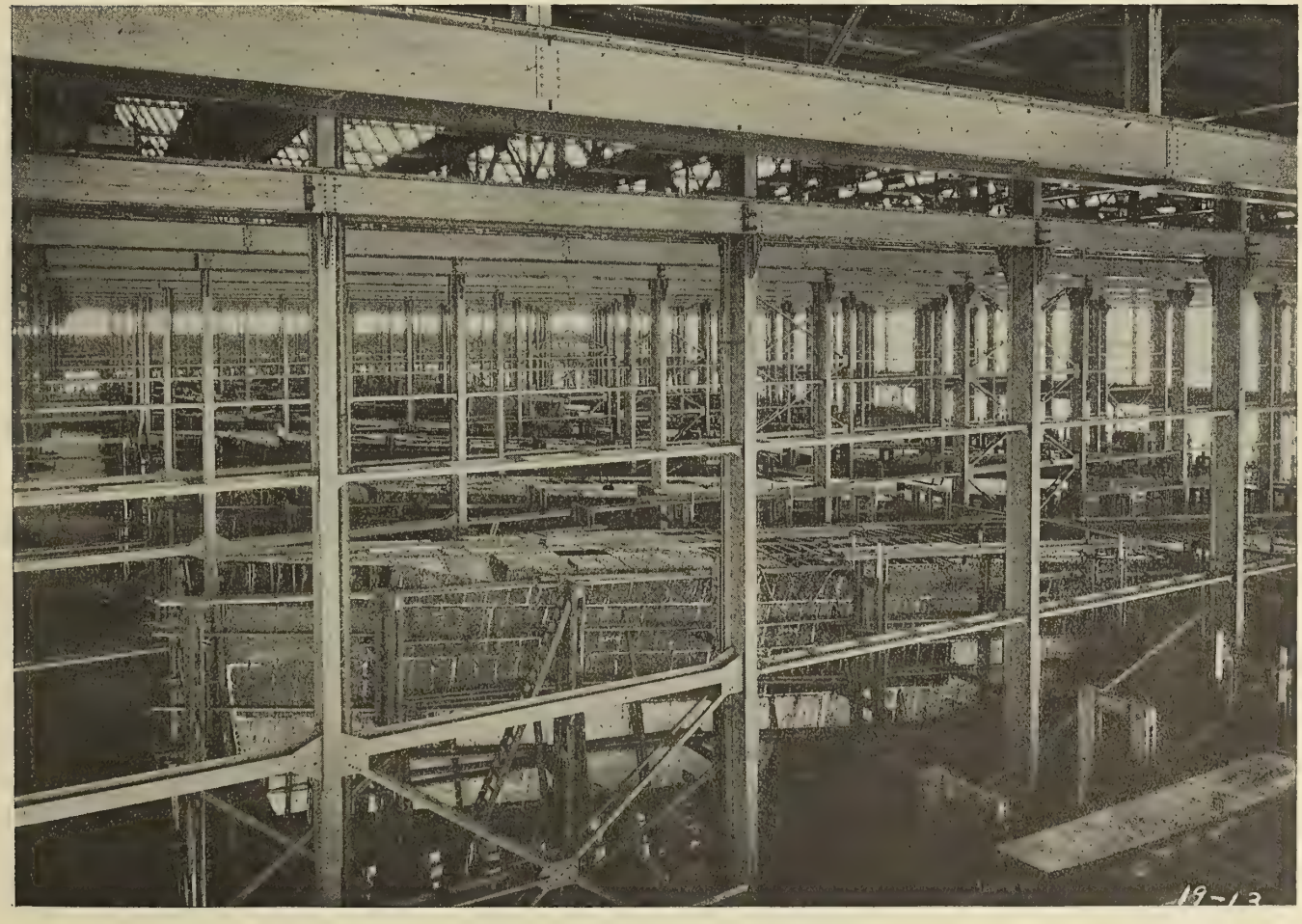


Fig. 11.—General View of Building Slips

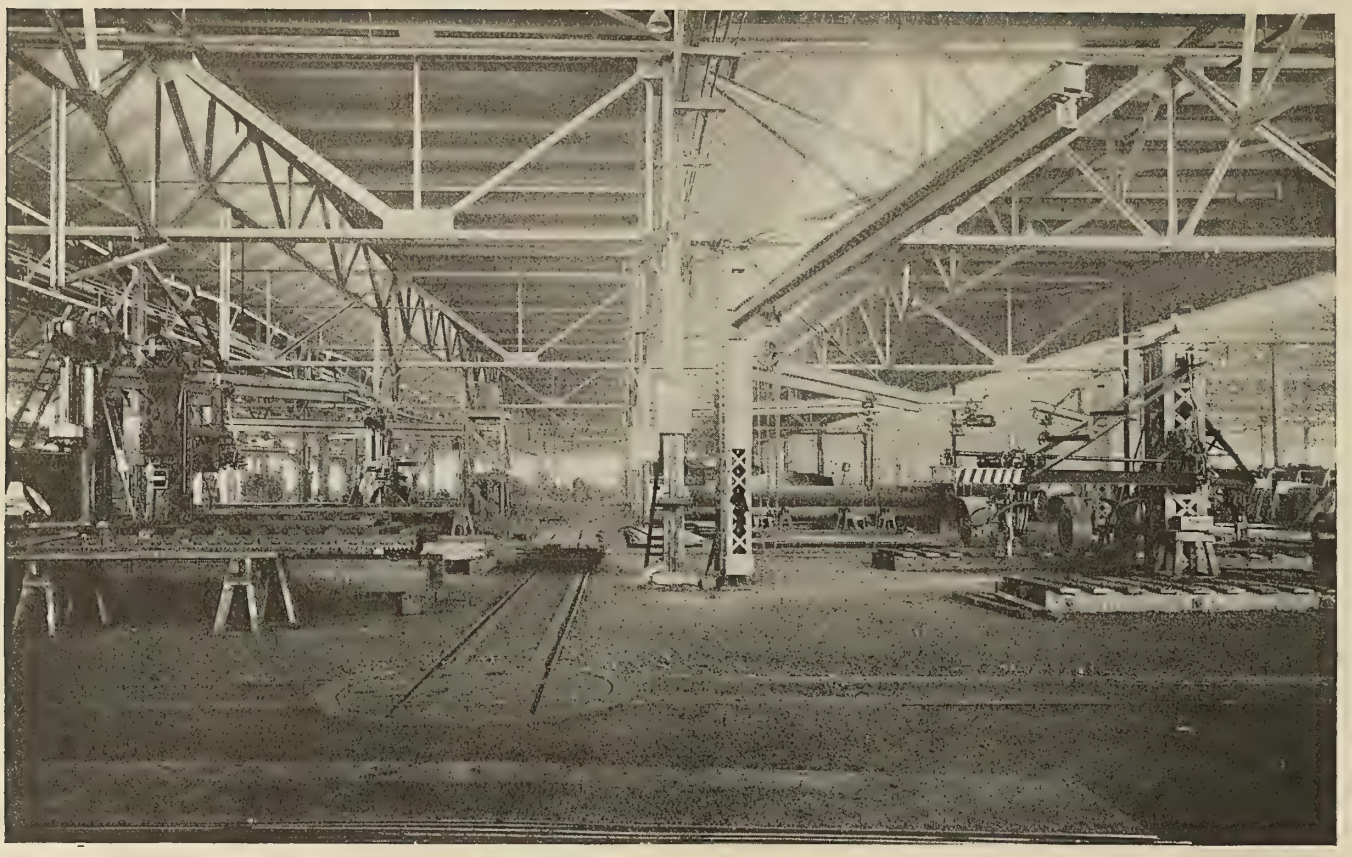


Fig. 12.—Interior of Plate and Angle Shop



Fig. 13.—Laying-Out Space in Plate and Angle Shop

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Fig. 14.—Bulkhead Assembly



Fig. 15.—Finished Storage at Head of Building Slips



Fig. 16.—Mold Loft



Fig. 17.—Interior of Machine Shop



Fig. 18.—Open Fitting-Out Dock



Fig. 19.—Interior of Wet Slips with Destroyer in Berth

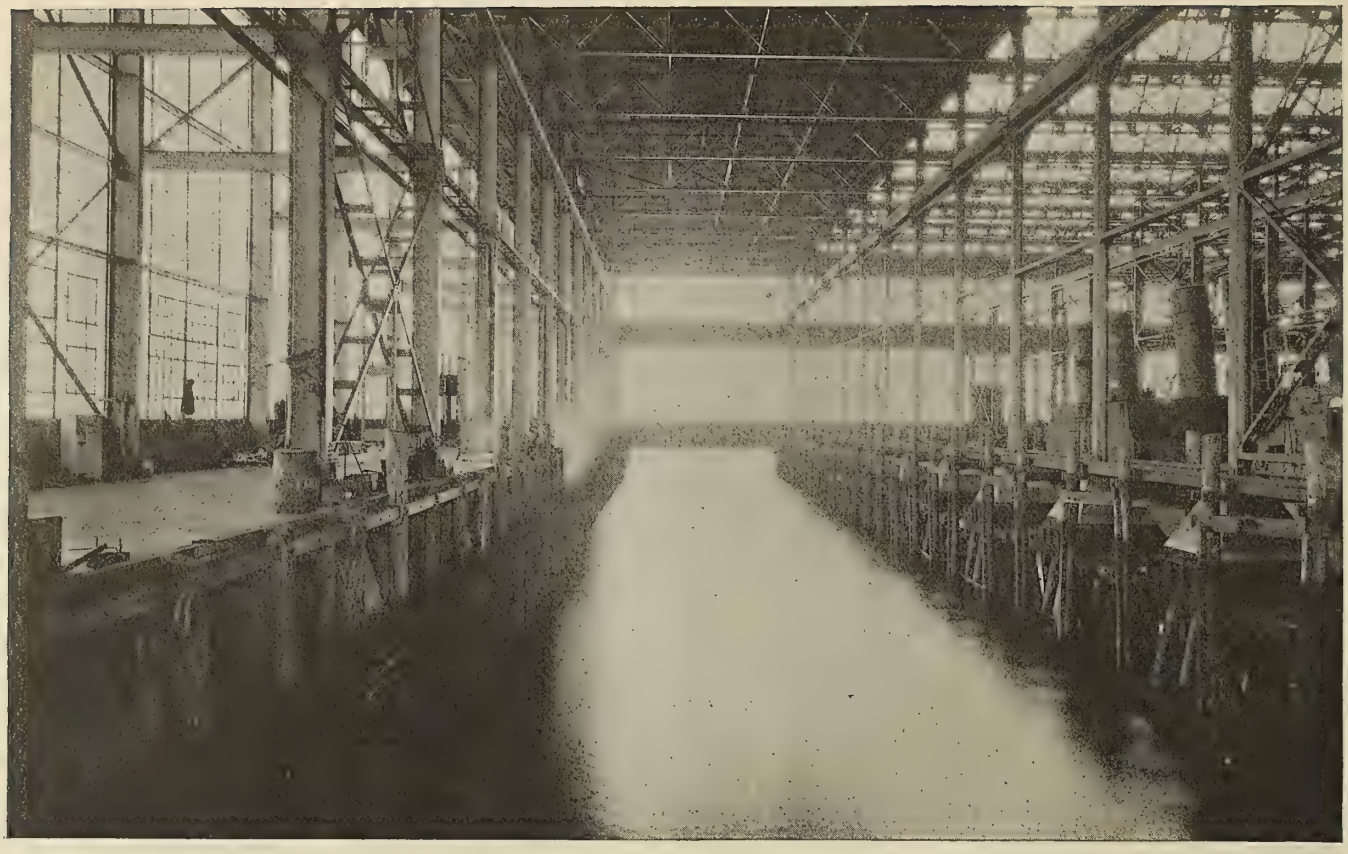


Fig. 20.—Wet Slip, Showing Pile Foundations

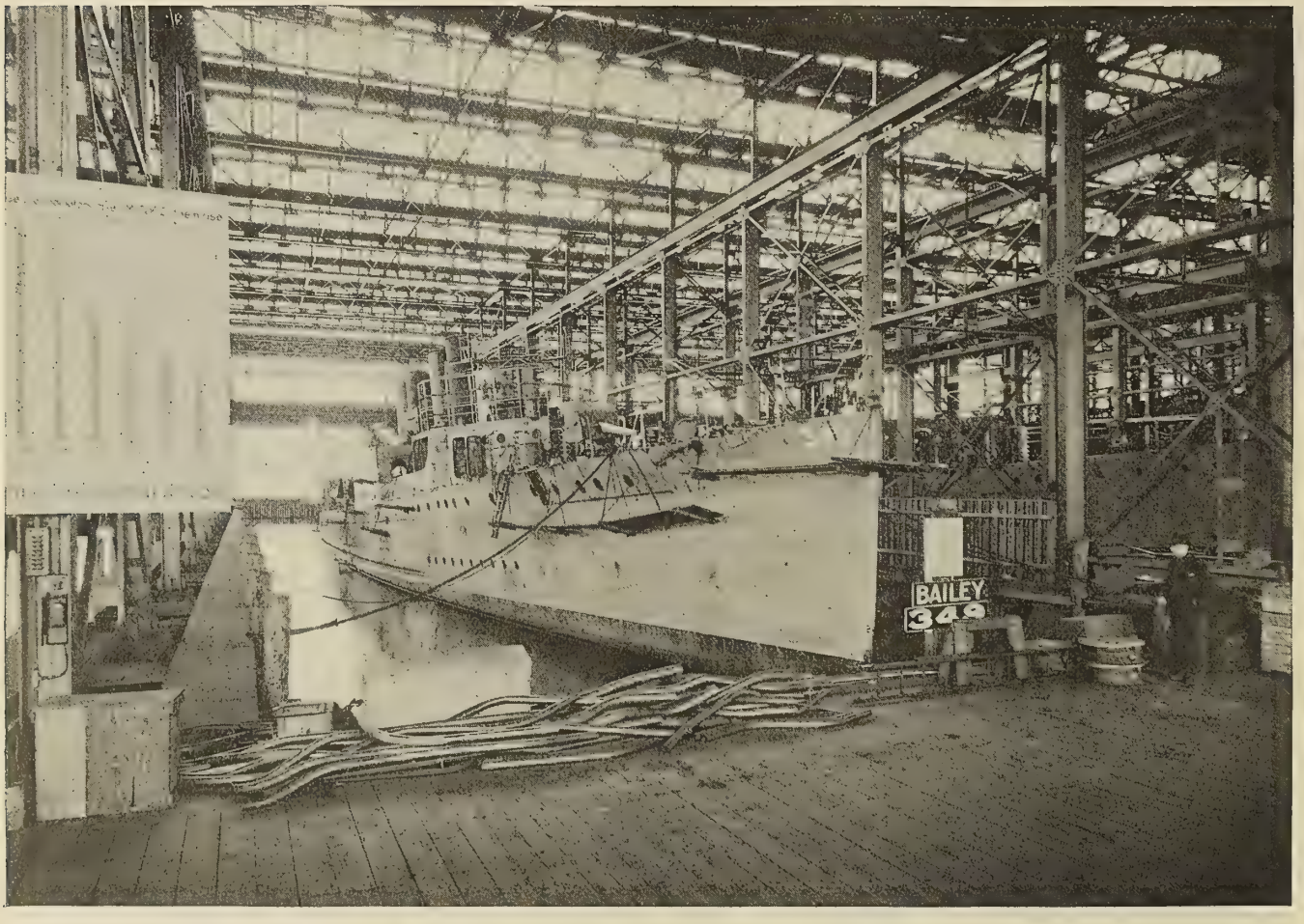


Fig. 21.—Destroyer Being Fitted Out in Covered Wet Slip

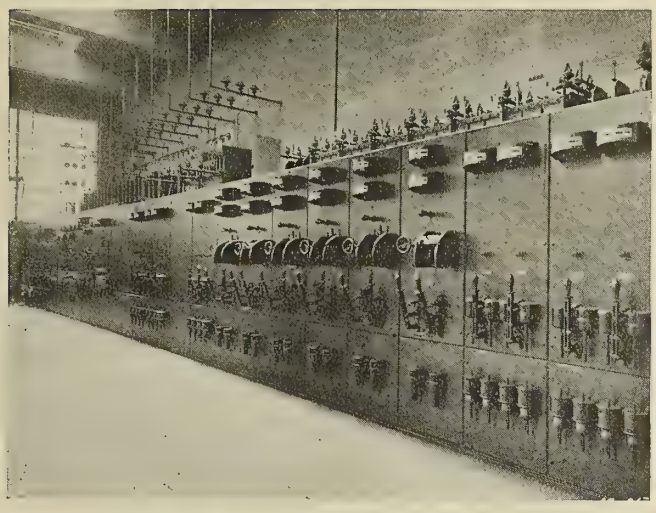


Fig. 22.—Front of Switchboard

North of the storehouse is located the boiler house and power plant. Power is obtained from the Edison Electric Illuminating Company and furnished at 13,000 volts. In the power house are two rotary converters for supplying direct current, and six air compressors having a total capacity of 10,000 cubic feet per minute.

Power Plant

The entire plant is equipped with automatic sprinklers with two fire pumps and a 100,000-gallon overhead tank.

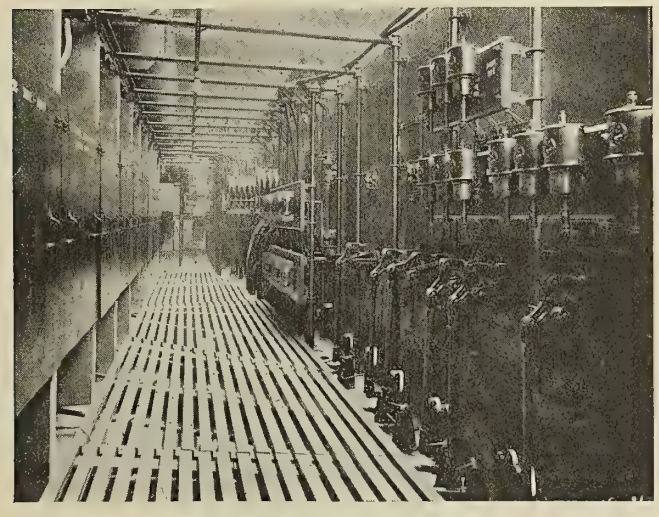


Fig. 23.—Rear of Switchboard

The plant has rolling stock consisting of ten locomotive cranes, two locomotives, and many flat and gondola cars.

Just south of the storehouse is the office or administration building, which contains also the offices of the United States Navy inspectors, and on the top floor a restaurant for office employees. The men working in this plant are well provided for with ample washroom facilities and a restaurant just outside the main yard.

Of all Government plants, including emergency war buildings, the Victory Plant gave the Government the least trouble, and is probably the only plant entirely free from criticism. From the beginning of the design to the completion of the plant there was as little friction here as in any of the large undertakings.

From the first it was expected that this plant would render real service in turning out destroyers. No spectacular effort was made to launch the first destroyer quickly, but rather the aim was to produce the greatest number of destroyers during the first few months following the completion of the plant. The building of this plant was so rapid, in spite of its being constructed during the worst winter recorded by the weather bureau, that the first destroyer was launched on July 18, 1918, nine months after Monks & Johnson were commissioned to proceed with the plans and specifications. This great speed of production was largely due to the co-ordination of the various buildings and the general layout of the plant; in fact, the arrangement is so logical that Mr. Harrold Yarrow, of Yarrow & Company, Ltd., of Scotland, and Yarrow's, Ltd., British Columbia, who recently visited this country on a tour of inspection, said, "Nowhere have I seen so well arranged and equipped a plant for turning out torpedo-boat destroyers as there is at Squantum."

Scotch Boilers Rolled 28 Miles Along California Coast

BY C. W. GEIGER

The accompanying illustrations show the different stages in the movement of six marine boilers aboard the full-powered motorship *Alabama*. These boilers were salvaged from the wrecked steamship *Bear* on the northern coast of California by the Porter Wrecking Company.

It was originally planned to ship the boilers to Shanghai on the steamship *Rosewood* under charter of the Overseas Shipping Company in November, 1917. When the vessel was ready, however, it was found, after repeated attempts,



Fig. 1.—Six Boilers Salvaged from S. S. *Bear*

that it would be impossible to get the boilers off the beach at Cape Mendocina, and the *Rosewood* had to proceed to Shanghai without the boilers.

A contract was then let to the Mercer, Frazer Company, Eureka, Cal., to haul the boilers along the beach to Eureka, 28 miles away. After five months the boilers

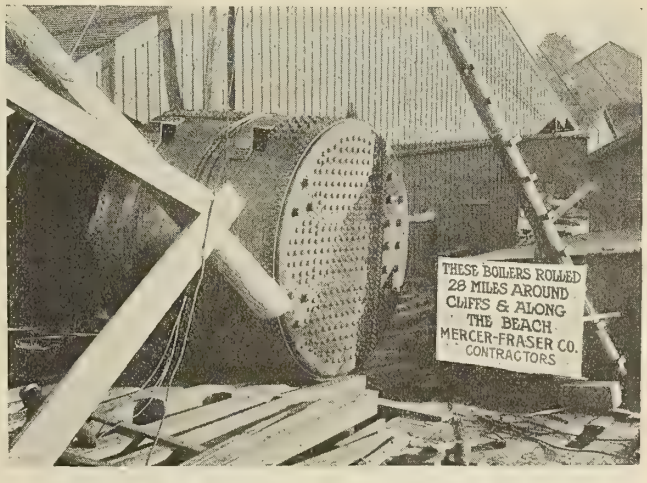


Fig. 2.—Equipment for Handling Boilers



Fig. 3.—Loading Boilers on Motorship *Alabama*

reached Eureka, where they were loaded on the *Alabama*, which carried them to Shanghai on her maiden trip. The boilers will be installed on three steamers which are being built at the Chinese Government yards at Shanghai for the United States Shipping Board.

The boilers were transported by rolling them around cliffs and along the beach. Barges were also used at three



Fig. 4.—Motorship *Alabama* with Cargo of Boilers on Deck

points to float the boilers over rivers and across the southern part of Humbolt Bay to Eureka. Fig. 1 shows the boilers aboard the barge being towed across Humbolt Bay. On reaching Eureka, the boilers were rolled off the barge onto the pier and later loaded onto the *Alabama* by means of the special equipment shown in Figs. 2 and 3.

Explosion in Boiler Furnace on Destroyer

An explosion in the furnace of one of the boilers of the United States destroyer *Aaron Ward* occurred at the Navy Yard, Boston, Mass., on April 28. The boiler was of the Normand type, built by the Bath Iron Works, Ltd., and was being operated at the time, for port use only, with a steam atomized auxiliary burner. The fireroom was open and no blower was in use.

The fireman on watch either put out this burner or allowed it to go out, and then attempted to light it again from the brick work. This attempt failed, and was followed by the use of a torch, causing an explosion of the air vapor that had quickly accumulated in the furnace after the first attempt to light off from the hot brick work. No effort was made to clear the furnace with steam, as should have been done in accordance with instructions which had been issued.

The force of the explosion was such as to blow out the casing of the boiler on the front and sides, causing minor damage in the fireroom. Both firemen on watch were badly burned about the face and arms by the flareback.

Welding a Broken Stern Frame

WHEN the huge 526-foot army transport *Northern Pacific* ran aground in a dense fog only 300 yards from shore, off Fire Island, Long Island, N. Y., on January 2, 1919, the daily newspapers were filled with vivid accounts of the thrilling rescues by breeches buoy of her 3,000 passengers, including many wounded soldiers, the overturning of her lifeboats, and finally the successful efforts, although not until over two weeks later, of a fleet of tug boats in easing the steamship off the sand shoal and towing her to New York.

When the vessel was placed in a dry dock at the New York Navy Yard, Brooklyn, N. Y., it was found that her interior machinery was badly disabled, and her turbines were thrown out of alinement. A great many of her plates were badly battered, and had to be replaced with new plates. In addition to this, the problem arose as to what should be done with her 26½-ton cast steel stern frame, for just above the upper gudgeon the whole section of the stern frame was cracked through. The cross section of the break formed roughly a triangle, each side of which was about 2 feet in length. A view of the broken stern frame is shown in one of the illustrations.

Injury to Stern Frame

The high position of the stern frame break, because of the unusual circumstances which caused it, was unique in the history of stern injuries, most of which have occurred

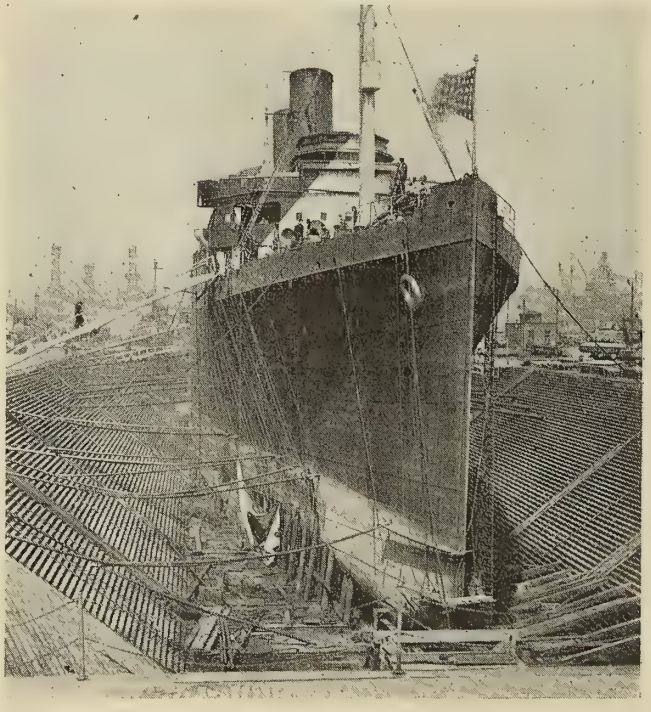


Fig. 1.—Transport *Northern Pacific* in Dry Dock at New York Navy Yard for Repairs



Fig. 2.—Close-Up View of Break in Stern Frame



Fig. 3.—Cutting Out a 3-Inch Gap for Thermit to Enter



Fig. 4.—Wax Pattern Completed, Previous to Building Mold

much lower on the steel frame, or on the stern shoe near its junction with the ship. The welding of this fracture also offered a special problem because the crack occurred in a hollow part of the casting, just above a solid heavy portion. The wall of the casting at the break averaged about 3 inches in thickness. The location of the break left the lower portion of the casting supported solely by a comparatively slender horizontal stern shoe, which must have borne a terrific strain during the ship's rough treatment when she was grounded. To alleviate this strain, after arrival in dry dock, the stern shoe was blocked up from underneath and a wooden beam inserted in the propeller aperture, acting as a brace against the stern frame.

In handling this injury a mechanical repair was considered out of the question, and there remained only the alternatives of welding the parts together, or of purchasing a new casting and installing it at a cost probably exceeding $50,000 (£10,250). Although the fracture was larger than any marine weld ever made before, the fundamental difficulties were not greater than those of many repairs of considerably larger size which are constantly being made by thermit process of welding in the steel mills. This process, therefore, was finally chosen.

One of the first factors in making this repair was that of overcoming the problem of inaccessibility. As the stern frame work was in an overhanging place about 20 feet above the floor of the dry dock, it was first necessary to construct a substantial scaffolding to provide a steady support for a mold box. Having erected suitable scaffolding, the next step was to provide a space for the thermit steel to enter in bulk and form a perfect amalgamation with the broken parts. This was accomplished by cutting out a 3-inch gap at the break with an oxy-acetylene torch. Careful measurements indicated that the two parts had already separated a sufficient amount to make up for the contraction of the weld as closely as that contraction could be estimated in advance.

Applying the Wax Pattern

In order to reach the hollow interior of the casting, for the purpose of applying wax for the inside part of the wax pattern and for building up the inside of the mold, it was necessary to cut about 4 square feet of plate out of the ship's inner hull with an oxy-acetylene torch. As the rudder had been unshipped it was impossible to climb up from the scaffolding into a small chamber just above the hollow space of the stern frame by way of the round hole, about 2 feet in diameter, of the rudder stock stuffing box.

After applying yellow wax to the inside of the broken

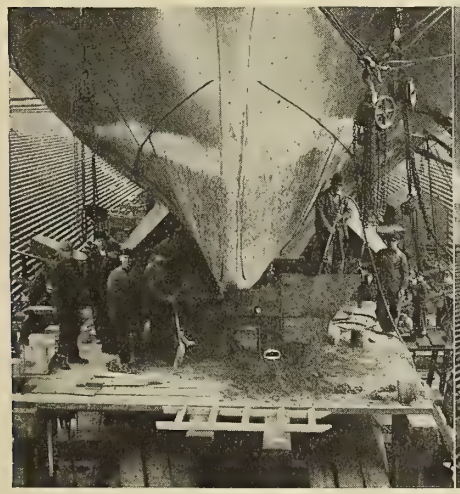


Fig. 5.—Ramming the Mold Box

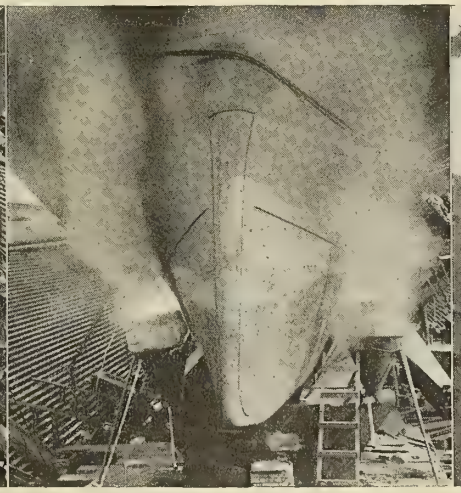


Fig. 6.—The Thermit Reactions

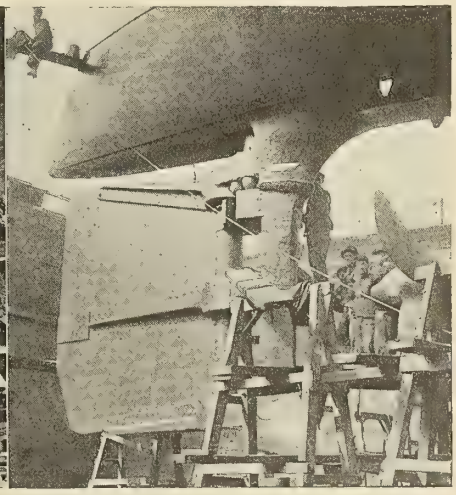


Fig. 7.—Completed Thermit Weld

section and placing a layer of wax on the floor of the hollow casting, molding material was deposited inside the casting and rammed up with a pneumatic rammer to a depth of 24 inches. Provision was made against the falling down of the molding material after the wax had burned out by inserting against the inside wall of the casting 5/8-inch iron gaggers bent inward at right angles to support the mold. The facing material placed adjacent to the wax consisted of one part fire clay, one part ground fire brick and one part fire sand. A wooden cylindrical riser pattern was vertically connected with the wax on the floor of the casting.

The interior of the casting having been rammed up, wax was next applied to the outside of the cut-out gap. A wax pattern was formed, varying from about 1½ to 2 feet in width, and bent upward on each side of the triangular casting at points where contact with risers was later to be made. Sixty-seven pounds of wax were required altogether for the wax pattern.

Constructing and Ramming Up the Mold

On completion of the wax pattern, a mold box was next constructed by cutting out the desired sizes of sheet iron with an oxy-acetylene flame, and bolting them into position. The finished mold box, with its base resting on the platform, had a rectangular, trough-like shape, as shown in the accompanying illustration, and measured 48 inches high, 51 inches on the sides parallel with the ship, 54 inches wide at the base and 10 inches wide on top.

In ramming up the mold box, the total quantity of molding material used amounted to 40 barrels of backing material and 6 barrels of facing material.

Insertion of Patterns

Heating gates were provided by inserting cylindrical wooden patterns through the bottom of the box on both sides and in the rear of the weld. Pouring gate patterns were connected diagonally downward through the top of the mold with the wax pattern. For outside riser patterns, a small narrow piece of a wooden plank was inserted close against each side of the triangular stern frame section and connected with the wax pattern below. These outside risers served the special purpose of applying molten metal for the thermit collar during cooling shrinkage, and thus prevented the thin casting shell at this point from sloughing away. All wooden and pipe patterns were removed before preheating.

Suspending Crucibles in Position

The suspension of the two No. 10 automatic crucibles with their extension rings over the mold box was accomplished by removing a rivet from the hull of the ship on each side at about 10 feet above the top of the mold box, and inserting eye bolts in these holes, from which chain hoists suspended the crucibles, as shown in Fig. 6.

The crucibles were held in place by removing two additional rivets, about 2½ feet apart, from each side of the ship at the height of the crucibles and lashing the crucibles against the hull by means of steel wire cables fastened around the crucibles and run through the rivet holes into the ship, where they were tied. The base of each crucible was rested on two angle iron rails laid across the top of the mold box. Each crucible was steadied by iron pipes braced between the crucible and platform. When in place each crucible was filled with 700 pounds of thermit, making altogether 1,400 pounds. Bricks were lined around the crucible extension rings.

As extra heat and fire precautions, asbestos was wrapped around the chains holding the crucibles, and asbestos sheets placed between each crucible and the hull of the ship. Molding sand was scattered over the platform to prevent its catching fire.

Preheating the Mold

At 8:15 A. M. on the day of the reaction, the operation of preheating the mold was started. The object of preheating was for the purpose of drying out the mold, burning out the wax pattern and for heating up parts of the steel at the location of and adjacent to the weld in order to secure a uniform contraction on cooling. Two gasoline (petrol) and compressed air preheating torches were directed through the sides of the mold box, a third down through the riser opening in the interior of the casting.

The preheating was kept up steadily for 7 hours. By 3:15 P. M. the broken sections had developed a very bright heat. Pressure was then turned off and the heating gates on the sides of the mold plugged up with clay.

The Reaction

As the time approached for setting off the reaction, the impending "fireworks" attracted the attention of several hundred naval officers, sailors and civilian employees, and the steps at the end of the drydock served as a great amphitheatre for the audience.

Both crucible reactions were set off simultaneously by stationing a man on a ladder at each crucible. At 3:30 P. M., on a signal, each man ignited with a red-hot rod the teaspoonful of ignition powder which lay on top of the thermit; then as the reaction started, jumped down and retired to a safe distance.

About 45 seconds were allowed for the liquid thermit steel to form from the reaction, after which time the two assistants tapped the crucibles by knocking out the tapping pins with long iron rods, thus allowing the molten steel to escape into the mold. The platform had been well sprinkled with sand and there was no danger from fire. The stray pieces of aluminum oxide slag were quickly covered with sand and rendered harmless.

The weld was allowed to anneal itself by cooling slowly, the mold box not being dismantled until the following day. When the molding material was finally cleared away, the risers and gates cut off with an oxy-acetylene torch and the weld examined by chipping off pieces of metal, the thermit steel was found to be a fine quality and appearance. The weld was then accepted by the Navy Yard representatives as being entirely satisfactory.

Time Consumed in Making Repair

The total number of 14 working days taken to complete the job does not by any means represent the average time consumed for making stern frame welds. The other repairs on the *Northern Pacific* had detained her for almost four months' confinement in dry dock; there was, therefore, no hurry on the stern frame weld. Furthermore, this repair required extra time in the unusual preparation of erecting a high scaffolding and platform, and in the delay occasioned in preparing the interior of the casting. Nevertheless, had the stern frame job required more of a rush, the total time consumed on the repair could doubtless have been cut in half.

Change of Name.—The American Engineering Standards Committee, New York, has just completed and adopted a revision of its constitution which has been sent to the governing boards of all the departments and societies represented on the Committee with a request for its ratification. The new constitution changes the name to American Engineering Standards Association, indicating the wide scope of the interests involved.



Fig. 1.—Panoramic View of South Portland Yard, Cumberland Shipbuilding Company, Looking West

Cumberland Shipbuilding Company

New Yards Erected at Portland, Me., for Building Wood Ships, Installing Machinery, and Repairing Both Wood and Steel Vessels

IN April, 1917, a number of business men in Portland, Me., were approached by agents of the United States Shipping Board to make a thorough investigation of the working conditions of the wooden shipyards in the State of Maine. This preliminary work was undertaken in conjunction with The Moulton Engineering Corporation, of Portland, with the result that it was found that very few established yards cared to interest themselves in Government work. This finding necessitated the construction of the present plants of the Cumberland Shipbuilding Company, in order that Maine should live up to its traditions as the home of wooden shipbuilding.

Many sites were investigated, with a choice of the present location at Cushing's Point for the shipyard and marine railway; the "installation plant" being located at Ligonia, three miles away on the shore of Fore River. Both plants are served by the Boston & Maine Central railroads, with Cumberland County Power & Light Company electric engine service for points beyond.

The shipbuilding and repair plant lies just west of Fort Preble between two hills of ledges, on about 23 acres of low, marshy land, which had to be properly drained before filling. A sandy beach bounds the northeast side, upon which four complete pile and timber shipways were constructed, each pile being fully tested with a 20-ton weight to secure proper support for the keel blocks. The declivity of the beach is about 7/16 inch to a foot; the shipways are at ¾ inch per foot, thus necessitating dredging a basin right across the whole space of the shipways to a mean depth of 10 feet at mean low water, which, with a mean high water of 9 feet, gives a total depth of water for launching of 19 feet. The waterfront is unrestricted by channels, sands or shoals, therefore launching stops or devices for checking are unnecessary.

Layout of Plant

The layout of the plant combines the latest and best features of the old and new yards constructing this type of ships, with a view to receiving, piling and milling lumber so that a continuous flow from the yard to the ships may obtain, with no retracing action. The system of wood fabrication was held to rigidly, which means that every part of the ships possible was either completed by machinery for the building platforms ready for placing or brought complete from outside sub-contractors in order that the old-fashioned hand hewing work would be reduced to a minimum. The working areas between hulls and shipways were completedly planked.

Ground was broken late in August, 1917, for the construction of the shipyard, with completion for keel-laying January 3, 1918. On August 16, 1917, a contract for nine "Ferris" type wooden hulls, of 3,500 tons deadweight each, complete with fittings, masts and rigging, was signed with the United States Shipping Board, Emergency Fleet Corporation. Through the non-delivery of material, considerable time was lost in the early days of the contract, but much of this handicap was soon overcome and the first ship, the *Cumberland*, was launched on June 29, 1918, in 135 actual working days.

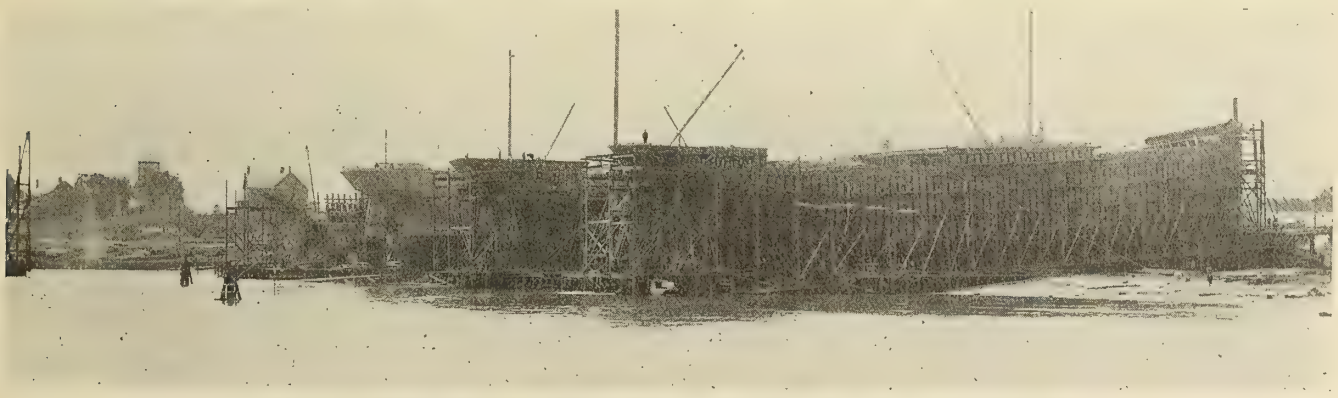


Fig. 2.—Building Slips on August 5, 1918, Showing Four Ways Fully Occupied



Fig. 3.—Plan of South Portland Yard, Cumberland Shipbuilding Company

Ten quarry-type wooden derricks, arranged as shown, were erected to care for the proper handling of material, with steam winches located at the bases for operating the hoists and bull-wheels. These derricks have proved very satisfactory for speedy operation.

Standard gage tracks serve a considerable portion of the yards.

Shipways

Four pile and timber shipways were installed to take vessels up to 300 feet in length by 50 feet in breadth. These ways are spaced 100 feet centers, which gives ample room between the ships for laying out necessary work and storage of material.

Each way is served by two steam operating derricks, mounted on high wood timber pedestals. Wire rope is used throughout for falls and guys.

Piling of Timber

A complete layout, blueprinted for the lumber checkers and sorters, was prepared, giving unit marks, sizes and lengths for properly storing under the derricks and facing the railroad track each member of the ship, which was

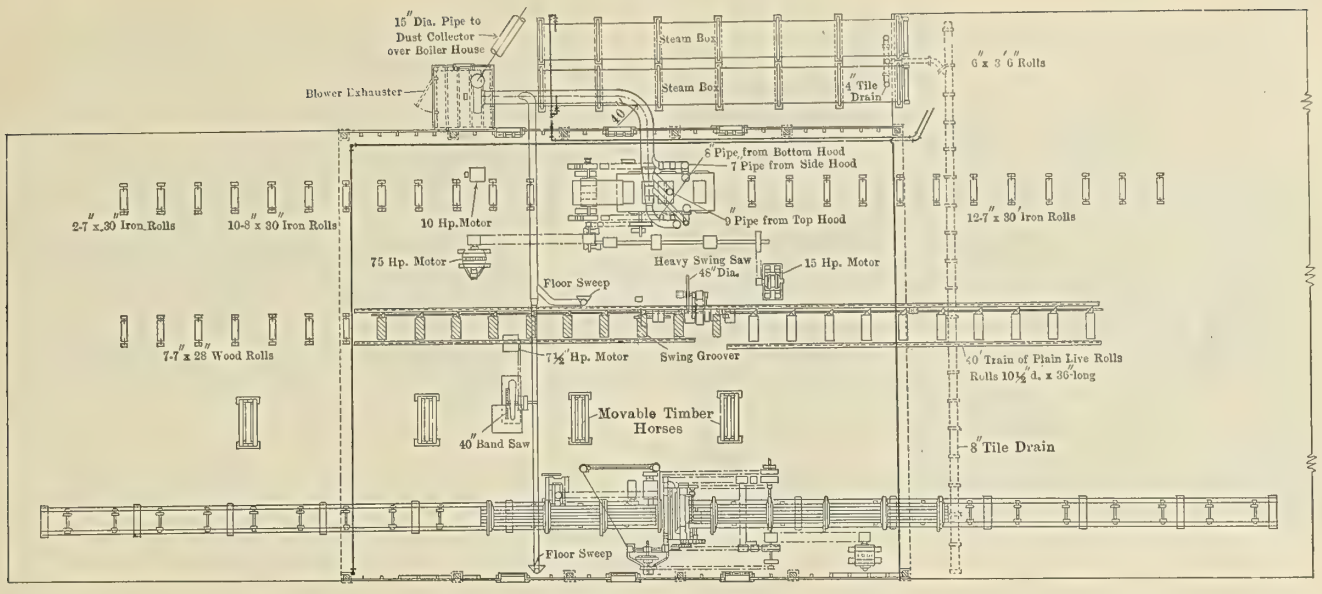


Fig. 4.—Plan of Heavy Timber Mill

found to be a wonderful time-saver and allowed systematic receiving for starting through the mills.

Saw-Mill

The saw-mill for splitting heavy logs and timber is 128 feet long by 16 feet wide, equipped with a No. 2 Lane, power-feed saw-mill, carrying a 60-inch circular saw. This machine is actuated by a 75-horsepower, 440-volt, 3-phase, 60-cycle motor.

In addition, a 30-inch circular cut-off swing saw, actuated by a 5-horsepower, 440-volt motor, is placed at the outer end of this mill for removing waste ends of timber.

The timber is hauled into the mill by a continuous chain drag, actuated by a gearing and clutches with the main motor.

Heavy Timber Mill

The timber is hauled into the mill by a continuous chain high, 60 feet by 60 feet, and is used for shaping, planing and surfacing lumber. Its equipment is strictly up-to-date, with a Stetson-Ross No. 11 machine complete, 20-inch side and 24-inch top heads, bevel planer which allows cutting timber to any angle. The heads are actuated by a 75-horsepower motor.

There is also a four-sided planer of 16-inch by 30-inch capacity, which in one operation surfaces neatly all sides of the timber. This machine is belted and independently driven by a 75-horsepower electric motor of 440 volts, alternating current. The equipment for this mill includes: One swing-cut-off saw of 48-inch diameter, No. 604 American; one swing groover, No. 2, B. G. Luther; one heavy 44-inch band saw; one set of power rolls for band and swing saws; two 15-horsepower motors for running these small machines.

Three overhead chain hoists on trolleys assist in handling the timber.

Ship Saw Mill

The ship saw mill is a one-story wood building, 54 feet by 24 feet, equipped with two power B-11 double bevel band saws having 38-inch diameter wheels. These machines are actuated by two 15-horsepower, 440-volt, 3-phase, 60-cycle, A. C. motors. There are also two self-contained swing cut-off saws with 10 horsepower motors and 40-inch circular saws.

The material is handled on portable roller horses, with two 3-ton chain hoists on trolleys overhead.

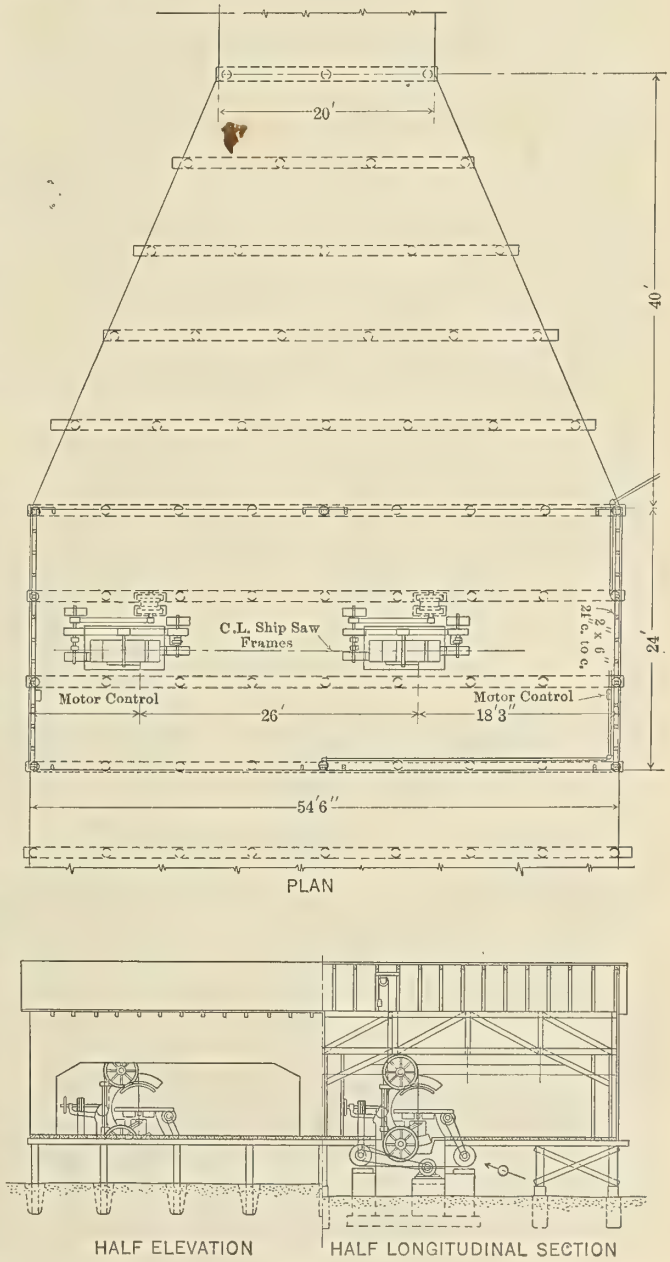


Fig. 5.—Plan and Elevations of Ship Saw Mill

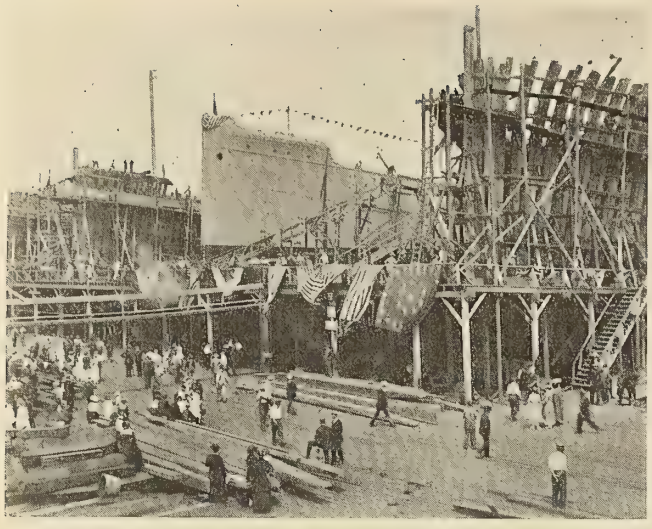


Fig. 6.—Just Prior to Launching Hull No. 383

This mill is used principally for cutting the main frames of the ships.

Exhaust System For Shavings

A complete electrically-operated fan with sheet iron ducts and a large collector tower, located over the No. 1 power house, handles all waste for the two last-mentioned mills to the boilers for fuel.

No. 1 Power House

No. 1 power house, a one-story brick building 41 feet by 29 feet, with annex 26 feet by 15 feet, contains a double unit arrangement for steam heating, and an air compressor fire pump and derrick winches, as follows:

Two 60-horsepower Nagle, locomotive-type boilers.

One horizontal feed-water heater.

One Blake & Knowles duplex feed-water pump, 4½ by 2¾ by 4 inches.

One water tank, 5 feet by 4 feet.

One Ingersoll-Sergeant steam air compressor, 16 inches by 18¼ inches by 18 inches, which delivers 600 cubic feet of air at 90 pounds working pressure.

One Sullivan angle air compressor, 17 inches by 9¾ inches by 12 inches, electric driven, giving 540 cubic feet per minute at 90 pounds working pressure. This machine is actuated by a 100-horsepower electric motor, with necessary switchboard, resistances and all other required fittings.

Two air receiving tanks of steel are located at the outside of this building, with banks of cooling pipes. Air mains of steel pipe lead to all parts of the working platforms, with hundreds of feet of ¾-inch rubber hose for connection to the tools.

"Little David" and "Little Giant" boring, calking, chipping and driving machines are used for expediting fastening, whereas grinding machines with 6-inch diameter saws attached are used for grooving the frames for the 4-inch by ½-inch iron strapping.

A No. 2 power house of brick, 35 feet by 15 feet, with concrete floor, contains one 60-horsepower Nagle locomotive-type boiler for assisting in supplying steam to the shipway derricks.

Main Building

The administration building is a two-story wooden building, 156 feet long by 52 feet wide, and contains the main offices, storerooms, junior shop, pipe shop and machine shop on the first floor, with engineering offices, cost department rooms, mold loft, rigging loft, saw filing department and social room for employes on the second floor.

The gate house and time office, a one-story wood building, stands guard at the main entrance to the yard, containing four main passageways with time clocks and card racks.

At the ends and between these passageways are located rooms for the purchasing agent, service manager, cost keepers, paymaster and guards.

Miscellaneous Buildings

The blacksmith and bolt shops, 40 feet by 24 feet and 16 feet by 16 feet, respectively, contain four forges, anvils, power hammer, motors, punches and shears, pneumatic bolt header, Hauck oil furnace, threading machines, Hill & Clark 24-inch drill press, rolls and trolleys.

The toolhouse, rigging loft and grindstone room are located in a one-story wood building, 25 feet by 60 feet. Here all air tools are properly cared for each night after the day's work.

Fire Protection System

A well-organized fire-fighting organization was built up,

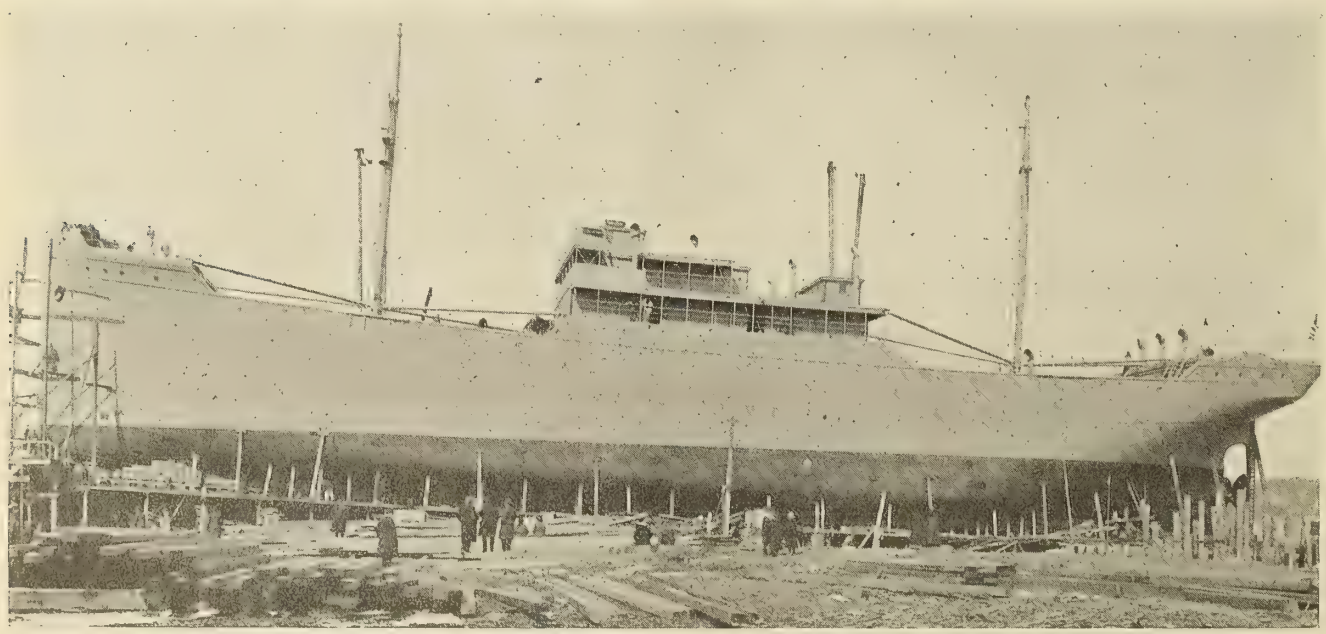


Fig. 7.—S. S. *Orhom* Nearing Completion on the Ways. This Vessel Was Launched on April 2, 1919



Fig. 8.—Installation Plant of Cumberland Shipbuilding Company

consisting of a marshal, assistant marshal, assistants and hose crews, which holds drills twice weekly. The yard is laid out into districts, each with its number, so that the steam whistle alarm tells the exact spot to seek when it is sounded.

A pump house of brick, one-story high, with a concrete and steel roof, contains a 1,000-gallon Worthington Underwriters' pump connected to the power house for steam, and a 107,000-gallon tank for water should the city water supply fail. A complete hydrant system, with proper pipe connections, is installed to span the whole working area of the yard, also 1,200 feet of 2½-inch fire hose in proper lengths is stored in hydrant houses.

Plant Training School

The management experienced considerable trouble during the early days of the contract owing to a lack of trained ship workers. To overcome this obstacle, house carpenters were employed, placed under competent foremen right on the job, and intensely trained into competent ship workers. Fasteners and calkers were trained in a similar manner.

Welfare Service and Employment Departments

A well-organized department, directed by trained service manager, cares for the health and recreation of the employes. Accurate card records are kept of each employe to allow placing to suit each individual.

A "first-aid" room, with full equipment, is provided, with a trained nurse and surgeon in constant attendance.

For recreation and amusement, a full-piece band and a glee club were formed to supply the plant with good music. Baseball teams and other athletic departments were organized. Public speakers have been invited to address the men at bi-monthly meetings to present the topics of the day to the employes at noon recess.

Records of accidents are published, which assists in reducing to a minimum lost time and carelessness.

This department is very much alive and does everything possible to keep the employes interested, which causes them to feel that the executives are with them and they are part of the plant. Foremen's meetings are held regularly to discuss plans for improving the efficiency of the plant, with splendid success.

Record Construction

In attempting speed records, one "Ferris" type wooden

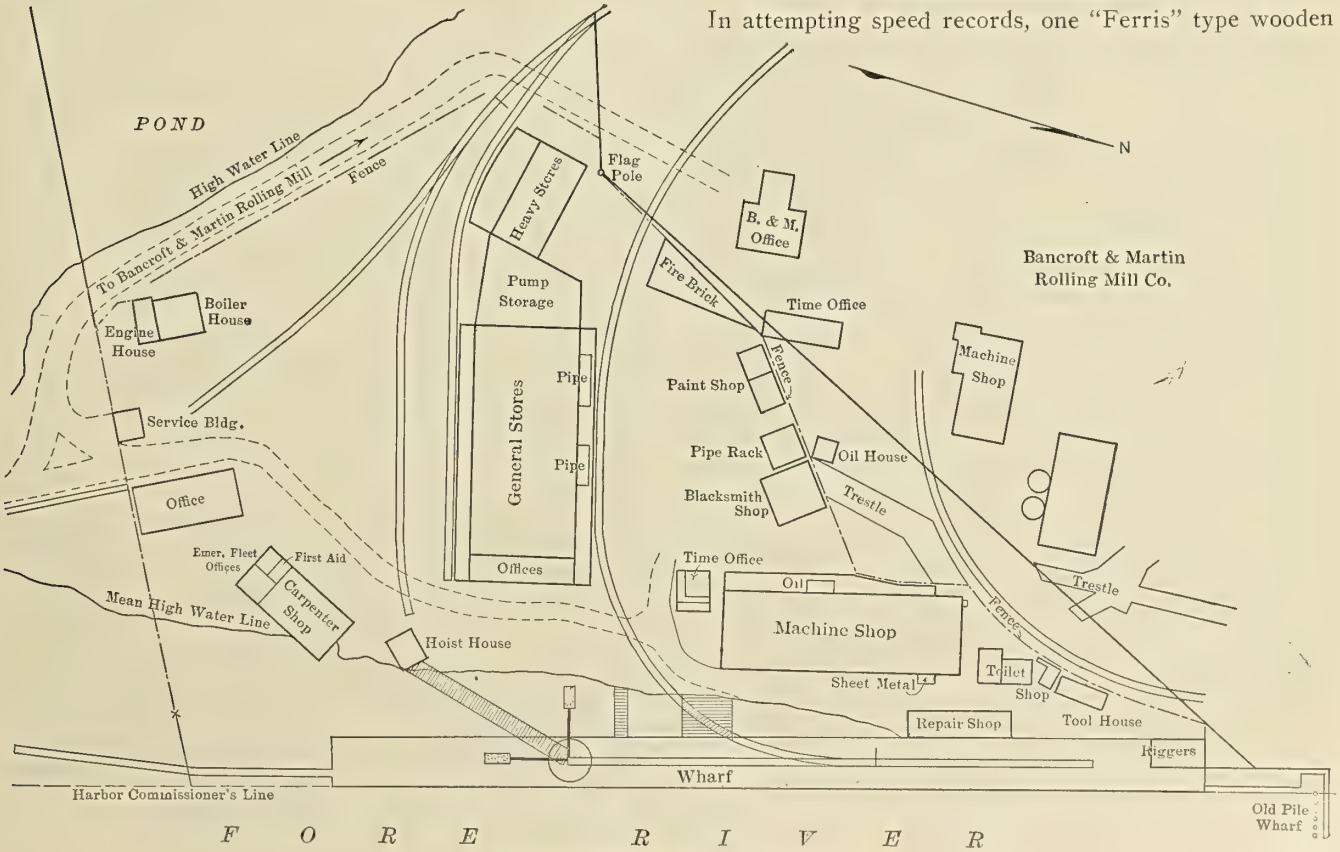


Fig. 9.—Plan of Installation Plant

ship was built in 135 working days. Another ship was fully square framed, set and ribbanded in 34 working hours.

Labor-Saving Devices

Many labor-saving devices were invented and used by the Cumberland organization. A port cutting machine for holes for air ports and a grab handle hole machine for hatch covers are worthy of special mention.

Compressed air machines are used throughout, replacing hand hammer and maul work.

The Installation Plant

A fully-equipped plant for installing machinery in the finished hulls was constructed and opened for work in July, 1918, with a contract with the Emergency Fleet Corporation for ten ships. This was later increased to 20 ships.

This plant is located in what is called the back river arm of Portland harbor, and is above three bridges, namely, the South Portland bridge, the first Boston & Maine railroad bridge and the Vaughan street bridge. It is just below the second and main line Boston & Maine railroad bridge. The water area between the Vaughan street bridge and the main line Boston & Maine railroad bridge is approximately 1,000 feet between bridges, with a full depth channel of approximately 500 feet in width at low tide from the face of the pier.

The depth of the water from the face of the dock across the entire width of the channel is approximately 17 feet at mean low water. The working wharf is about 500 feet long, with two wings approximately 200 feet additional to the dolphins set for a ranging line for ships tied up at the working dock. The location is well sheltered.

There is no undertow at any time, and the tide current is very slow, making it an ideal spot to moor ships during the worst weather conditions. The shops, storehouses and yards are located on a piece of property adjacent to the Bancroft & Martin Rolling Mills Company, embracing approximately 5 acres. It is completely fenced in and made up of a fill of rolling mill slag and gravel. The nature of this fill prevents the formation of mud, and the yard is practically as dry following a hard rain as at any other time.

There are ample trackage facilities, as will be observed by reference to the plan, throughout the yard and on the wharf. The buildings are of substantial mill type. For fire protection, a White gasoline (petrol) pumping engine, with chemical attachment, is provided, together with ample hose to put several lines in commission at any time in any part of the plant. Its location in Portland, adjacent to the rolling mills above mentioned, is an ideal one from the standpoint of material and supplies.

The plant is steam heated throughout, from a central boiler plant located within the yard. The electric cars pass over Vaughan street bridge, providing ample service to the city, and stop within a stone's throw of the gate.

Fitting Out Berths

There is one fitting out wharf 500 feet long, with space at the end to allow the docking of two ships 300 feet long. Due to the character of the basin, it has been possible to handle as many as five ships at one time, placing them two and three abreast.

The wharf is equipped with a stiff-legged derrick, of 30 tons' capacity, capable of lifting 15 tons on a 50-foot radius. In addition to the above lifting rig, the plant has two locomotive cranes, one with a 60-foot boom, capable of handling 30 tons on a 12-foot radius, and one with a 30-foot boom, with a capacity of 12 tons on a 14-foot radius. The tracks are extended down the wharf, enabling the locomotive cranes to serve the ships that cannot be reached by the stiff-leg derrick.

Motive Power

Electricity is used exclusively, except on the hoisting apparatus mentioned above, which is run by steam. The equipment consists of four 10 horsepower 220-volt motors, for the running of all machine tools in the various shops, and in addition to this, one 100-horsepower 2,300-volt motor, driving the air compressor, which has a capacity of 709 cubic feet.

The air compressor is a Sullivan machine, with high and low presure cylinders, at right angles to each other. A pipe system is led from the compressor plant, furnishing air to the machine shop, pipe shop and copper shop, and also to a pipe line along the wharf for use on shipboard.

Machine Shop

A complete equipment of machine and hand tools is installed in the machine shop, making it possible to perform any kind of repair work on a ship, except the very largest parts, such as propeller shafting, main engine cylinders and the like. The largest lathe is a 24-inch by 14-inch Round-Larmon. By means of blocks under the head and tail stocks, this lathe has been changed so as to take a 30-inch swing over the bed.

This plant is well equipped with air tools for work on the ships, and, in addition, several riveting hammers, as well as bolt drivers, air-driven, are installed. There are two oxy-acetylene torches, one large Oxweld outfit, and a smaller Waterhouse welding outfit.

Blacksmith Shop

The blacksmith shop is located in a separate building, and is equipped with five forges with individual electric-driven blowers, anvils and all necessary hand tools for every forge.

Pipe Shop

The pipe shop is equipped with two pipe threading machines, capacity up to 6-inch pipe, one bending slab and two Hauck oil torches for heating of pieces for bending. The shop is also fully equipped with hand tools of various kinds, such as pipe expanders, stocks and dies, etc.

In connection with the pipe shop, there is also a copper shop, equipped with two charcoal burning furnaces, as well as Hauck torches for auxiliary heating. In this shop is a press with the assistance of which copper pipes up to 7 inches in diameter are handled.

The yard also has a force of electricians, with the necessary tools for doing all kinds of electrical work on board ship, a paint department and a rigging department of heavy machinery, and also experts in the rigging of vessels, standing rigging as well as running.

The two plants furnish facilities for turning out complete ships, ready for sea service.

New 15,000-Ton Floating Dry Dock Built and Operated by Skinner & Eddy Corporation

THE new 15,000-ton dry dock recently built and now operated by the Skinner & Eddy Corporation, Seattle, Wash., is of the sectional type, having five pontoons, each 90 feet long by 126 feet 8 inches in width.

Each pontoon is capable of lifting 3,000 tons, and can be operated singly, or with others in any number of units. The total length of the five pontoons when operated as a



Fig. 1.—S. S. *Edgehill* Docked in New Skinner & Eddy Floating Dry Dock

unit is 459 feet, with a depth of water over the keel blocks of 24 feet.

The dimensions of the pontoons have been so arranged that any one pontoon in need of repair may be docked within another. When operating as a unit, the pontoons are connected together by locking logs, which serve to tie the pontoons together and keep them in alinement.

Pumping Machinery

Each pontoon is divided with two 20-inch vertical shaft centrifugal pumps manufactured by the Morris Machine Works, Baldwinsville, N. Y., located low-down in the pontoon, one on each side under the towers. From each pump branch pipes 14 inches in diameter are led to each of the three watertight compartments on that side of the pontoon, each pipe being controlled by a gate valve operated from the top of the tower. A foot valve is fitted at each of the suctions.

Each watertight compartment is provided with an 18-inch flooding pipe which allows water from the outside to enter, and this water is controlled by a gate valve operated from an indicating stand on the top of the tower. This



Fig. 2.—View of Skinner & Eddy Dry Dock from Shore, Showing Schooner and Steamship in Dock at Same Time

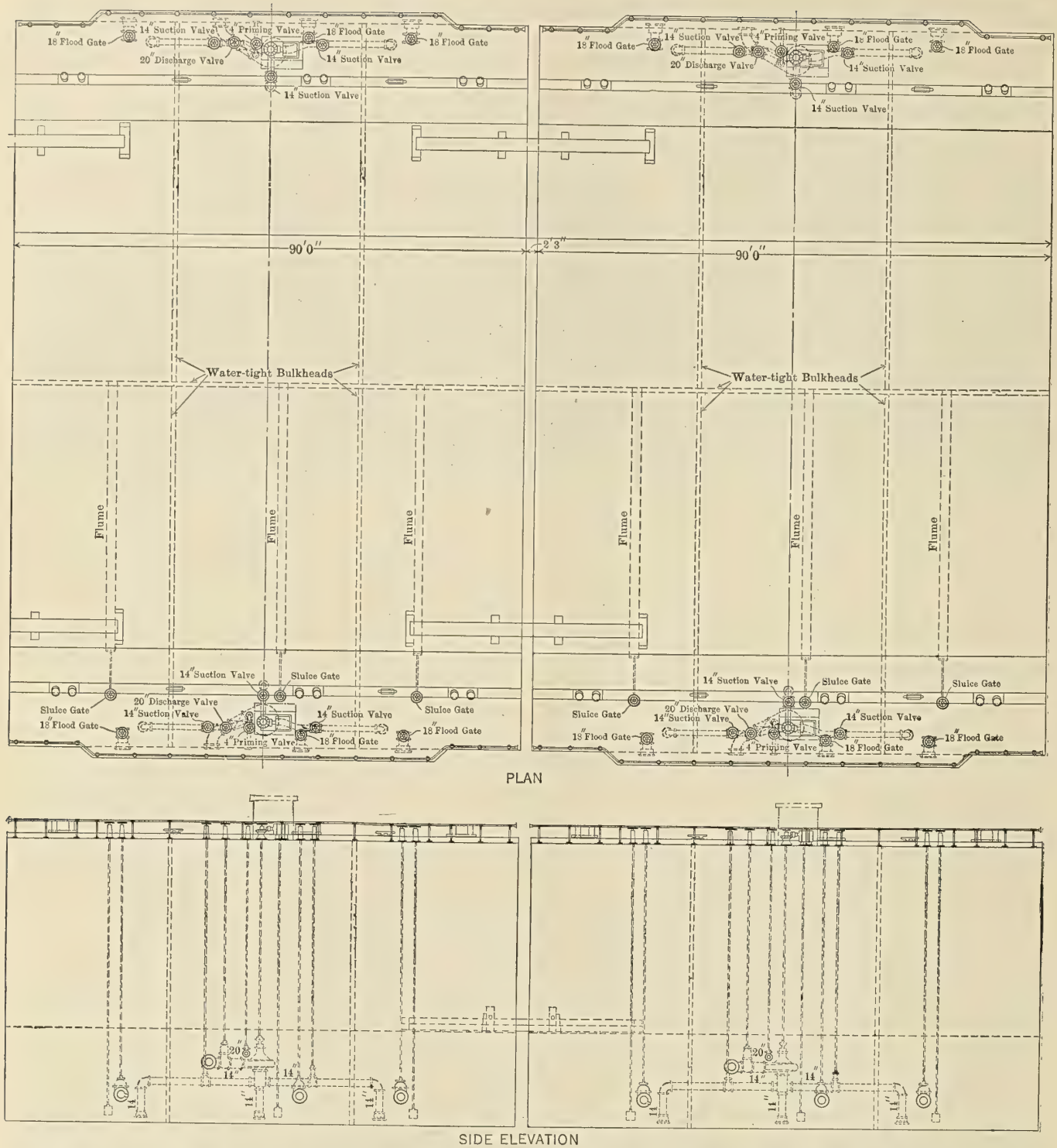


Fig. 3.—Plan and Elevation of Two Sections of Skinner & Eddy Dock, Showing Method of Locking Sections Together and Arrangement of Pumps

combination of pumping pipes and valves gives a very accurate control over the trim of the dock. The vertical shaft from each pump leads to the top of the tower, where it is driven by a 100-horsepower, 2,200-volt motor, the pump running at 300 revolutions per minute.

All motors are controlled from a central station placed on the wharf at the head of the dry dock. In this station are indicators showing the depth of water in each compartment of each pontoon, so that the operator has complete control of the raising and lowering of the dock.

There are three 2,500-horsepower electric capstans on each side of the dry dock mounted on top of the tower. These capstans were manufactured by the American Engineering Company, Philadelphia, Pa., and are used for hauling ships into the dock and placing them in position ready for lifting.

Audible Electric Signals in Industrial Plants*

BY V. KARAPETOFF†

No industrial plant of any magnitude may be considered fully efficient unless means are provided for promptly locating any important employee, no matter where he may be within the plant. A private telephone system, however extensive, serves this purpose only as long as the needed man is at his desk, but as soon as he leaves his desk the problem of locating him becomes a hit or miss proposition. On the other hand a superintendent, a foreman, a millright, a repair man, etc., is ordinarily

* Extract from a paper presented before the Rochester, N. Y., Section of the American Institute of Electrical Engineers on April 25, 1919, and before the Erie, Pa., Section on May 13, 1919.

† Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.

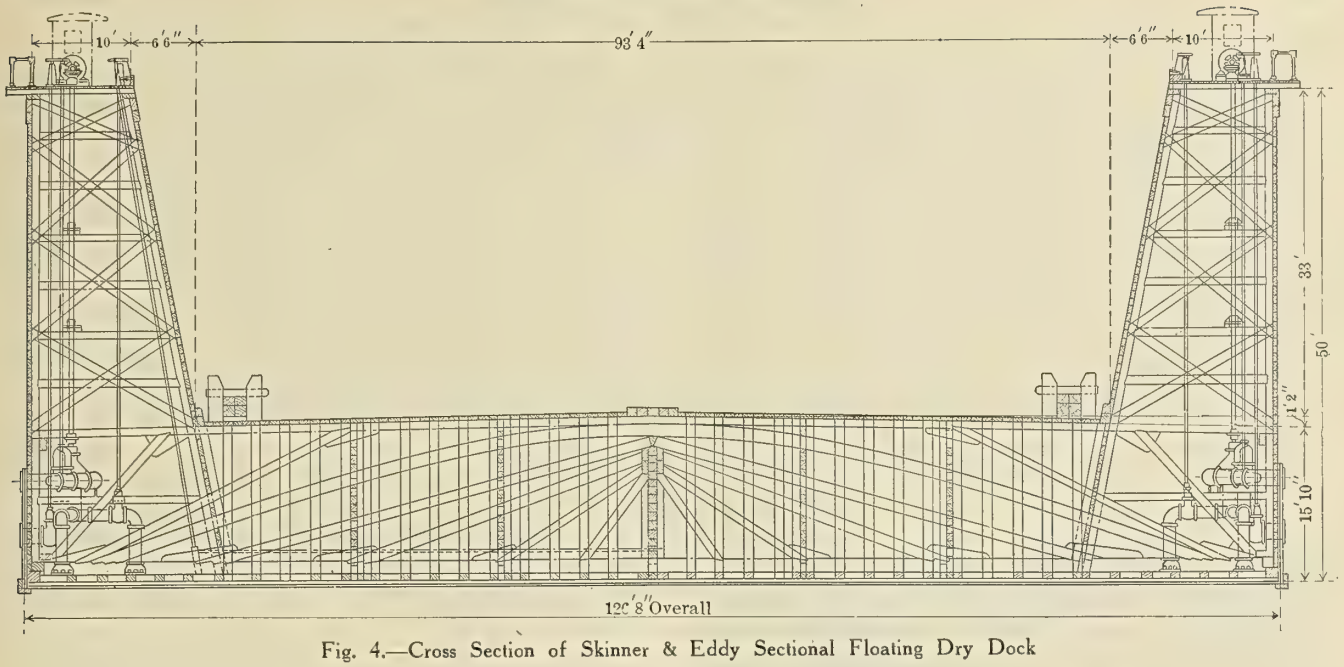


Fig. 4.—Cross Section of Skinner & Eddy Sectional Floating Dry Dock

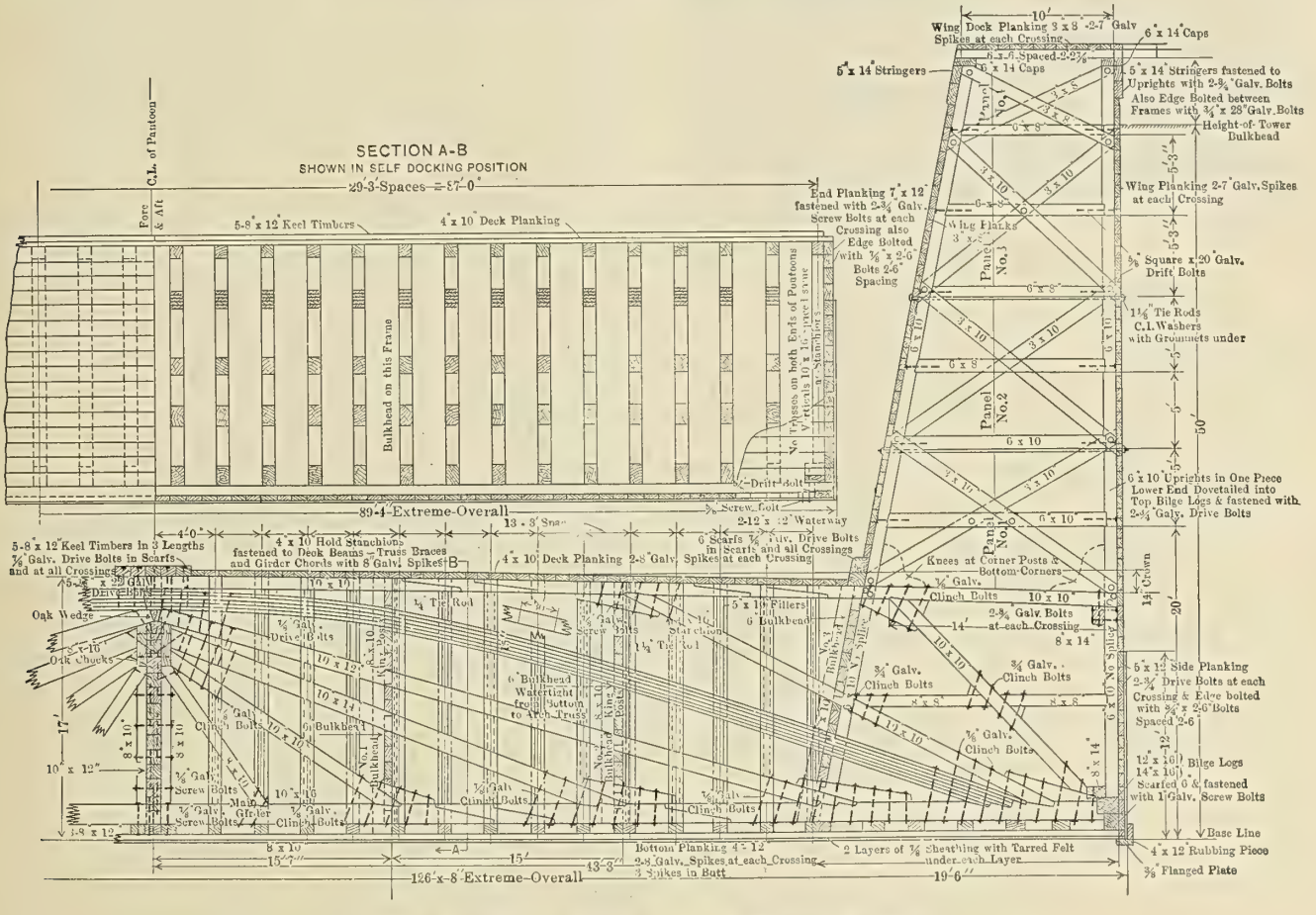


Fig. 5.—Midship Section of Dock, Showing Scantlings

useful only in so far as he can freely move about the shop without the fear that someone of importance may need him. Thus, within the last few years, under the tremendous impetus of the pressure for an enormous increase in the production of munitions of war, audible electric signals have been introduced into many industrial plants.

Such an electric signal is usually similar in construction to the familiar electric "horn" used on automobiles. It consists of a diaphram with an anvil at its center. A toothed wheel driven by a small electric motor strikes the anvil many times a second and causes it to vibrate vigorously. These vibrations produce the well-known warning tone, which carries over a considerable distance. The device is provided with a projector or horn the shape of which depends on whether it is desired to scatter the sound, to intensify it in a horizontal direction, or to deflect it downward. Such motor-driven signals are now made much more powerful than automobile horns, and are wound for 110 or 220 volts, direct or alternating current,

so that they can be connected to a lighting or power circuit, and do not require a separate low-voltage battery.

With such electric audible signals scattered throughout the plant it becomes an easy matter to locate instantly any person to whom a code number has been assigned. For example, when the manager wishes to speak to one of the assistant superintendents, who may be anywhere in the plant, he simply tells the telephone operator to sound this particular man's call. As soon as this assistant superintendent hears his call, he comes to the nearest telephone, and reports, whereupon the operator connects him with the manager.

It would be rather inconvenient for the telephone operator to sound various calls by hand; therefore a special code-calling automatic instrument has been developed for this purpose. The operator merely sets the desired person's code number on a dial and pulls a lever, a contact-making mechanism is thereby set in motion, which

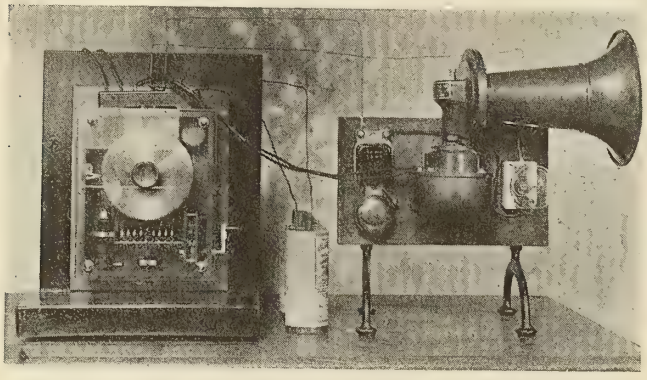


Fig. 1.—A Code-Calling Instrument (Klaxocator), and the Signals Which It Actuates, viz., an Electric Horn, a Bell and an Electric Lamp

closes the electric circuit and operates the code signals throughout the plant the required number of times (usually three times), and then stops automatically.

In noisy and in open places, or in large factory lofts, the electric horns mentioned above constitute the most suitable type of signal. In offices they may be replaced by less loud electric gongs, bells, buzzers, air whistles or incandescent lamps. In some cases two separate circuits are run from the code-calling mechanism, one circuit for ordinary calls, the other for fire-alarm gongs, or for some other special purpose. Sometimes two allied plants are operated side by side with a separate staff in each. Then the same code combinations can be assigned in both plants, but the horns in one or the other plant will sound according to which of the two circuits is closed.

A further application of loud electric horns in industrial plants is for extensions to telephone bells. The ordinary telephone ringer is not loud enough in many shops when the foreman is away from his desk. In this case, a relay is connected in parallel with or in place of the telephone ringer, and when it is actuated it closes a secondary circuit, which causes an electric horn to sound. This call should be a single blast to distinguish it from code calls.

Audible electric signal systems are also used in various plants as warning signals on cranes and hoists, also to call a shifting locomotive, to indicate the beginning or the end of a certain operation, and for other local purposes. Like in the case of any convenience, once such an electric signal system has been installed, the superintendent, the foremen, and even the operatives themselves will find new uses for it.

Shipyards have buildings scattered over a large area with wide yards between. Taking into consideration also the noisy character of shipyards, the importance of acoustic signals will become at once apparent. The three chief uses for acoustic signals in shipyards are: (a) To sound code calls for important employees, (b) To replace telephone bells in noisy places, (c) to sound warnings on cranes and other moving machinery.

Signals in Shipyards

The large capital involved in the production of ships, the necessity for high-priced experts and for rigid, closely connected organization, all make the installation of a sufficient code system imperative; the trifling expense involved is entirely insignificant in comparison with the beneficial results achieved.

Now that such code-calling systems are available it is almost incredible that a large shipyard should continue in operation without any provision whereby the important members of the staff could be instantly put in communication instead of playing hide and seek with each other. If one could compute the loss in production and the increased overhead charges because of such delays the figures would be unbelievable.

The inconvenience of direct communication between two parts of a ship hull or between two ships under construction makes it necessary to have a more elaborate code, telling each important man, not only that he is needed, but also where he is to go and whether or not it is an emergency call. This saves a great deal of climbing of stairs and ladders and permits the overseeing force to utilize their time more efficiently.

Marine Applications of Signals

The hazards of the sea to-day demand an equipment which will not only fill the needs of routine service, but which will also prove unfailingly efficient under the stress of emergency. The intercommunication and signal equipment is the nerve system of the ship. During emergencies it becomes the one and only means which enables the officers to direct and co-ordinate the operations of the ship and its crew. Upon the signal equipment may depend the ship's safety. Voice tubes, gongs, whistles, etc., find their place, but for some purposes powerful electric horns are indispensable. A large number of such horns have been recently installed in various United States naval vessels. They can be used as a warning of hazards, as fire-alarm signals, for general alarms, as hoist signals, and also for code calls throughout the ship.

Another use which has not received sufficient attention is for communication between ships at a short distance from each other, or between a ship and the shore. Audible signals should have a distinct useful field for distances beyond the carrying power of a megaphone, and where wireless communication is not available. They can be operated at a much higher speed than an inconvenient and sluggish steam whistle, which, moreover, is supposed to be sounded for other purposes.

Dry Docks Building for Emergency Fleet Corporation.—According to a recent statement made by the United States Shipping Board Emergency Fleet Corporation there are now being constructed for the Emergency Fleet Corporation seven floating dry docks with a total capacity of 72,000 tons and twelve marine railways with a total capacity of 34,400 tons, making a total capacity of dry docking facilities now under construction for the Emergency Fleet 106,400 tons. The largest of the floating dry docks is of 20,000 tons capacity, while the largest marine railway has a capacity of 4,000 tons.

Rosseter Discusses Development of Trade Routes for the New Merchant Marine

J. H. Rosseter, Director of Operations of the Shipping Board, stated to the representatives of the national organizations which gathered in Washington on May 22 to discuss the problems centering around the future of our new merchant marine, that in his opinion the question of trade routes is really at the bottom of the whole problem.

"If we should make the mistake of a promiscuous use of this fleet under any random sale or charter," he told the conference, "and fail to conserve to the nation the present opportunity of building up regular lines, I am afraid that all of our efforts will have gone for naught. Without regularity, without some direction or control, without some control of needless competition between ourselves and the fierce competition that is coming to us, we are going to fail.

"Among the very important, and, I might say, one of the most difficult problems we are facing, is the establishment of truly American organizations possessing a high degree of efficiency, in mechanical equipment, as well as in organization, to handle the business of our ships at foreign ports, to obtain a fair share of trade for return cargoes, and also to secure the advantages of triangular voyages.

"There are two problems that come very closely together—railroad and shipping. A proper survey of the shipping situation requires that we decide upon the best avenues of interior transportation. For example, the Gulf area for many years has suffered from the influence of the East and West railroads. Cargo has been hauled east and west that could have gone to the Gulf ports, not only because of more favorable and economical movement by land transportation, but because the Gulf, in certain trades, presents advantages in operation over North Atlantic ports, as in a like way, North Atlantic ports present certain advantages over Gulf ports.

"The Shipping Board has struggled with this and its other problems. The question of manning, the question of fueling our ships, the question of correct assignment of types to trades, has been dealt with conscientiously. We have been mindful of the fact that we have sometimes had to send ships that were too small on journeys that were too long. But we had our limitations and nothing else could be done. It was a case where we had to do the best we could.

"Now, we are coming to the time when we will have more and better ships, and the question we have to decide is one that must be decided from the standpoint of national interest—not in a spirit of suspicion that the shipping men are trying to take some advantage.

"We have in this whole shipping problem the greatest opportunity that was ever given to a nation. We have created a large fleet of ships—unbalanced, if you will, but which can be corrected by changing our type and changing our style of ship—and now we are proceeding to decide how we shall proceed to the control and direction of these ships.

"Without going into extended argument on the point, I might briefly sketch to you what the Division of Operations has been doing all these months.

"First, we have had the demands from the Army, and then the demands from the European Relief, but, from time to time, we were able to give some support to trade. Happily, we are coming to a time when we can give them much better support—cotton and coal and manufactured articles of this country, which have been suffering for a year past for lack of vessels, will gradually now get some relief.

"We proceeded on the theory of revising our fleet. The difference between an economical ship and the difference between a wasteful ship is the difference between success and failure. The type of ship and type of propulsion are changing every day. As far as we can, we have been readjusting these conditions, entrusting our ships to operating companies at home, and they are going abroad. The fleet is gradually piling up. There have been days when as many as five new ships have come to hand—the average has been twenty a week. It gets to be colossal; it gets to be so complicated and so complex and so far-reaching that, do the best we can, we get poor headway with it. I am surprised that there has not been more criticism throughout the country than there has been.

"But, this is the problem: if we are to profit by all of the sacrifices we have made in providing these ships, at a cost of over three billion dollars, to build a 'bridge of ships,' we should study out now a very definite scheme of foreign trade. By foreign trade routes I mean this very important point, which I would like to impress on you; regularity of sailings in all of the ports.

"Reference has been made to the tramp steamer. The real instrument of advantage to the industry and agricultural interests of this country is to be best served by the regular liner. In that respect we can well afford to take a page out of the book of the late German Empire. To illustrate: in times before the war, and right up to to-day, our mails have not been carried in our own ships. Before the war our manufacturers received an inquiry from such an important, but remote, market as South Africa, and they would not know beyond a few weeks in advance what shipping opportunity was open to them. Contrast with that the oportunity of the manufacturer or agriculturist to know every month of the year what date a ship would sail from a given point to a given destination. Couple that up with the great advantage we could derive from the unscrambling of our railroad situation.

"The Government can function very well, but I know that it is difficult for the Government to establish proper agencies in other sovereign countries. That, it seems to me, is a matter of domestic enterprise. I would proceed along the theory of future management of ships from the standpoint of economic operation and the best results for all interests in this country to divorce the Government from the operation. That is the way it impresses me very strongly. Entrust it to private enterprise; impose on the private enterprise all of the restrictions and all reasonable guarantees and regulations with good sense and foresight will permit—maximum rates, if you will; a guarantee of sailings, the facility of through bill of lading in connection with your railroads, offering the small shipper the same opportunity as the large shippers had in the past, because the large shipper could provide himself with a vessel and load it entirely, whereas the small shipper was limited to the opportunity presented in the so-called berth business."

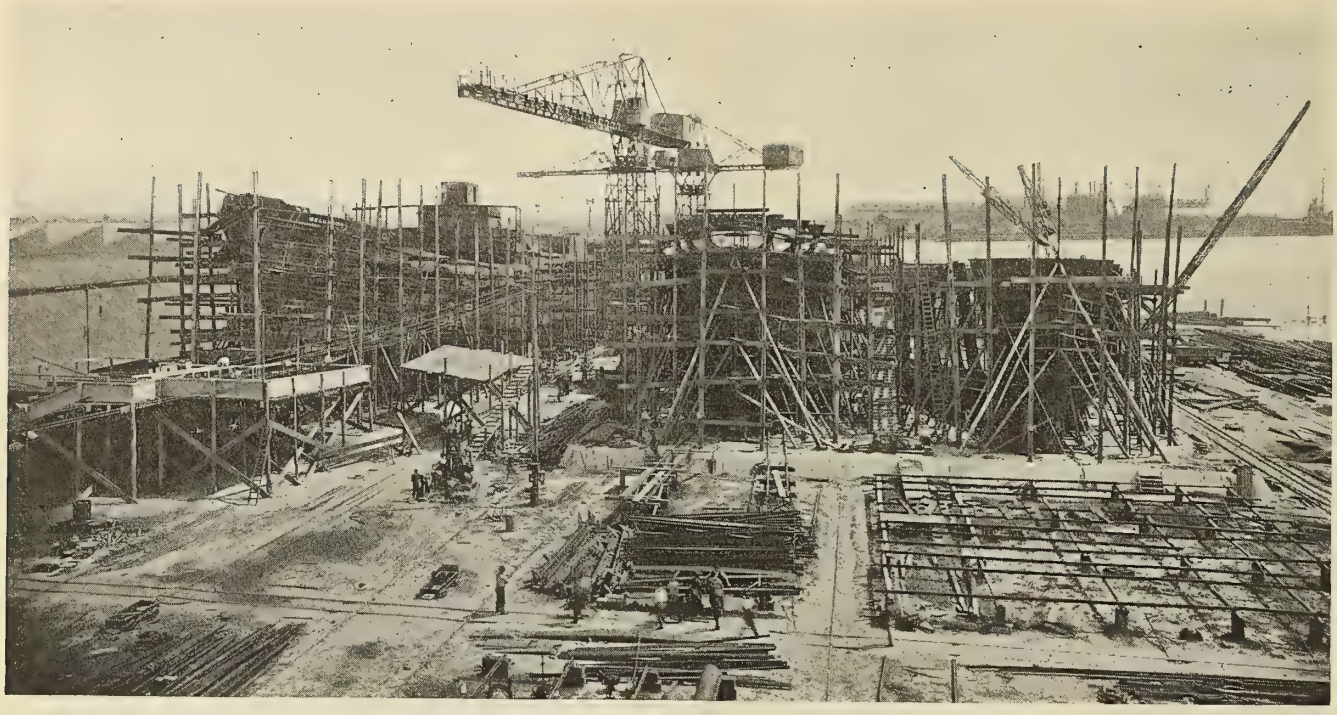


Fig. 1.—State Government Dockyard, Walsh Island, Newcastle, N. S. W. Building Ways Showing Three of the Australian Standard Ships Under Construction

Shipbuilding in Australia

Government Dockyards at Newcastle and Sydney Turn Out Cargo Vessels and Trawlers—Repair Facilities

DURING the past few months, the Commonwealth of Australia has completed the first serious attempts at ship construction in her history, and from the success of her efforts it is believed possible to supply, with present equipment, all necessary naval auxiliaries, cargo and coasting vessels required by the Commonwealth.

Two Government dockyards, one at Walsh Island, Newcastle, and another at Sydney, have accomplished very favorable results in connection with this construction. At present there are five 5,500-deadweight ton cargo ships in various stages of completion on the ways at Newcastle, while another ship of the same type was launched on March 25, 1919.

The Newcastle yard is on a small island, which is ideal for the work, because of its natural sand foundation, the possibility of expansion by the reclamation of land from the river and its accessibility to the Broken Hill Proprietary Company's works, which is the only plant in Australia at present equipped to roll ship plates. Newcastle is surrounded by coal fields, making power in this section cheaper than practically anywhere else in Australia. The yard was originally intended for Government work, but the management has been given power to make contracts with private firms, so that equipment might be efficiently utilized.

The Honorable R. T. Ball, Minister of Works of New South Wales, is chairman of the Board of Control, and has a very able engineering staff to assist in carrying out

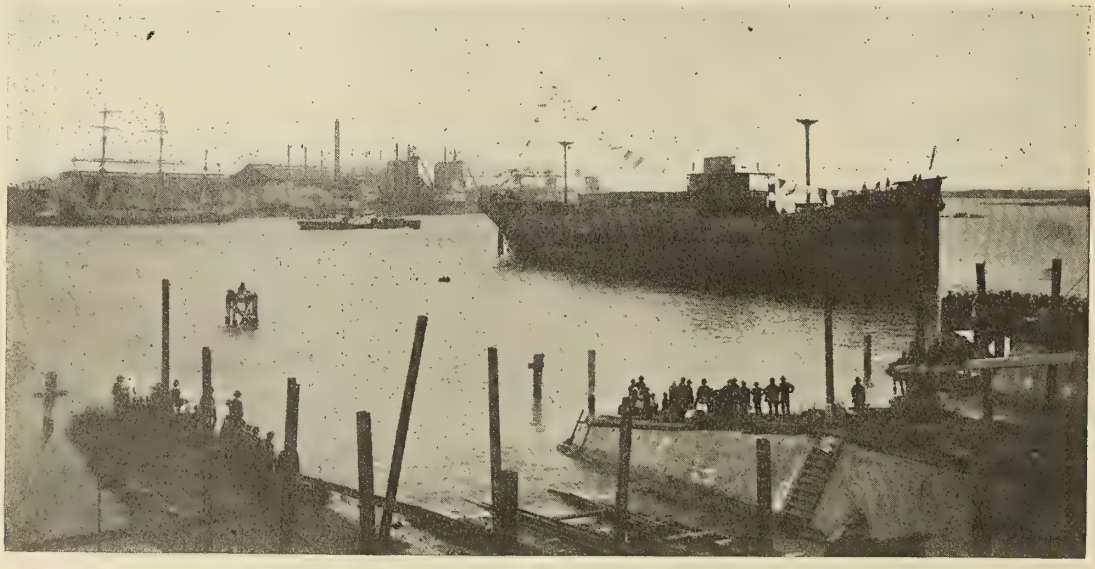


Fig. 2.—S. S. *Delungra* Taking the Water. Launched at Newcastle, March 25, 1919

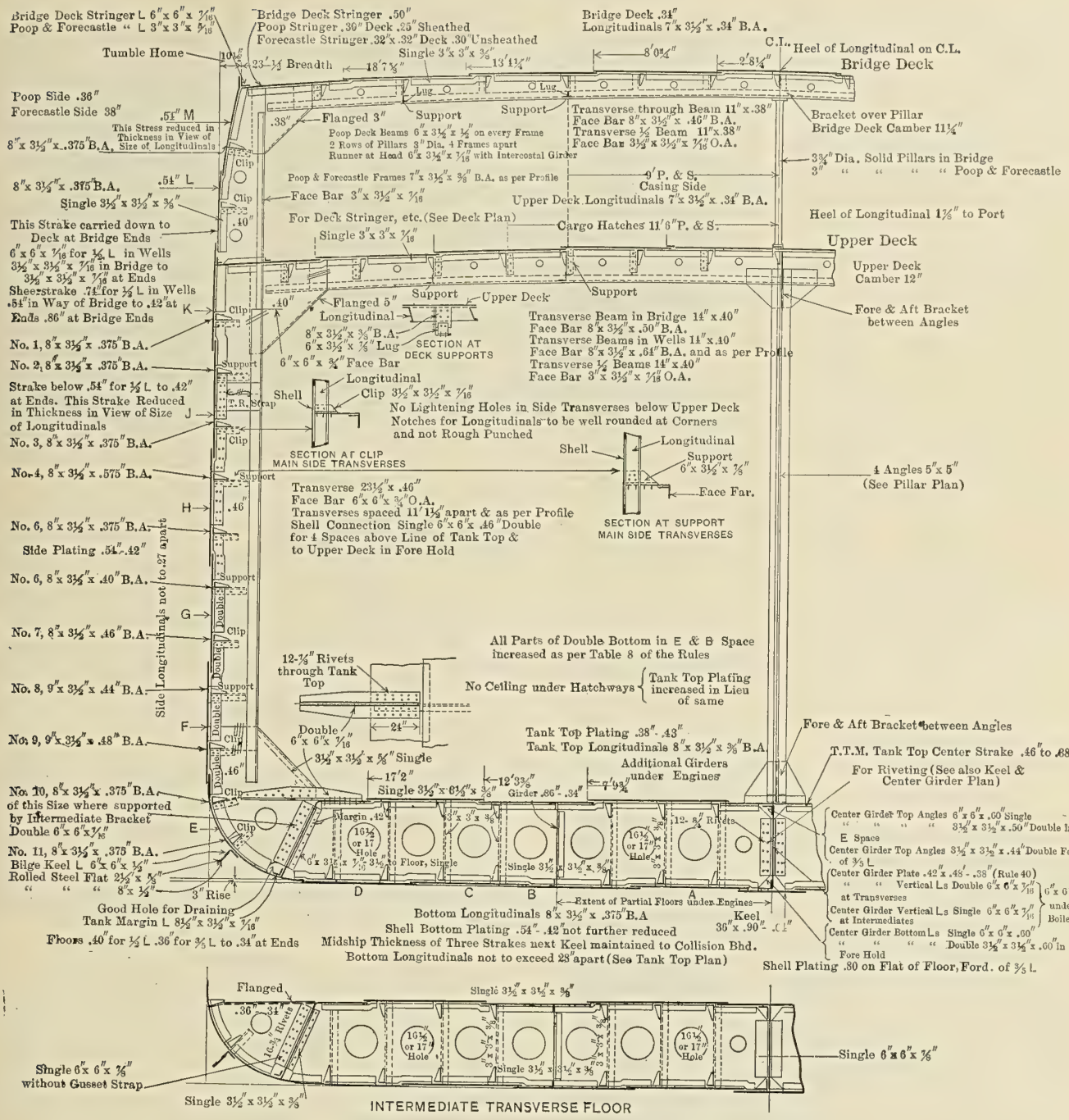


Fig. 4.—Midship Section of Commonwealth Standard 5,500-Ton Ship

details. Repair slips for vessels up to 800 tons adequately care for coasting and small cargo ships requiring attention. The shops are fitted with modern, labor-saving equipment, and are capable of supplying the yards with material for practically any sized vessel required in the Australian service.

The success of the first 5,500-ton ship, the *Delungra,* has encouraged the management to attempt the construction of several 10,000-ton vessels. The *Delungra* was built to Lloyd's A1 specifications on the Isherwood system of framing, with a double bottom extending from the tunnel recess bulkhead aft to the collision bulkhead forward, and with a main deck, bridge, poop deck and forecastle.

The principal dimensions follow:

Length overall	341 feet 6 inches
Length between perpendiculars	331 feet 0 inches
Molded beam	47 feet 9 inches
Depth at side to upper deck	26 feet 1 inch
Load draft	21 feet 6 inches
Engine power	2,300 indicated horsepower
Boilers	3 Babcock & Wilcox
Speed	10 knots

The vessel has a straight stem and elliptical stern. She is lighted throughout with electricity and all cabins are steam heated. The joiner work is of Australian timber, the panelling of the saloon being polished rosewood. Officers' quarters are on the bridge deck, the master and wireless operators have cabins on the navigating bridge and the crew is accommodated in the poop. The ship's stores are carried in the forecastle and in a store room under the bridge deck. The piping arrangements are very complete for a vessel of this size. When fully loaded, the ship will displace about 8,000 tons.

Cargo is handled by means of four 5-ton steel derricks carried on the foremast and a 20-ton steel derrick is provided for handling heavy weights. The main mast also carries four 5-ton steel derricks. The ship is well equipped

with lifting gear, having eight main hatch winches and two bridge deck winches, each working a 26-foot steel derrick attached to a derrick post.

Steam is provided at a pressure of 180 pounds per square inch by three boilers of the Babcock & Wilcox type, having a combined heating surface of 8,289 square feet. Only certain portions of these boilers were imported, the balance being built and erected at Walsh Island. The engines are of the triple-expansion type, with cylinders having diameters of 25, 41 and 68 inches and a 45-inch stroke, developing 2,300 indicated horsepower.

All of the auxiliaries were built at the plant, including the condensers, with a cooling surface of 2,600 square feet, air and circulating pumps, feed, bilge and ballast pumps, feed heaters and filters, winch condenser, electric light engine and windlass, winches, steering gear, ventilating system complete and other fittings. The electric installation was supplied and installed by the Sutherland & Ashman Company, of Melbourne.

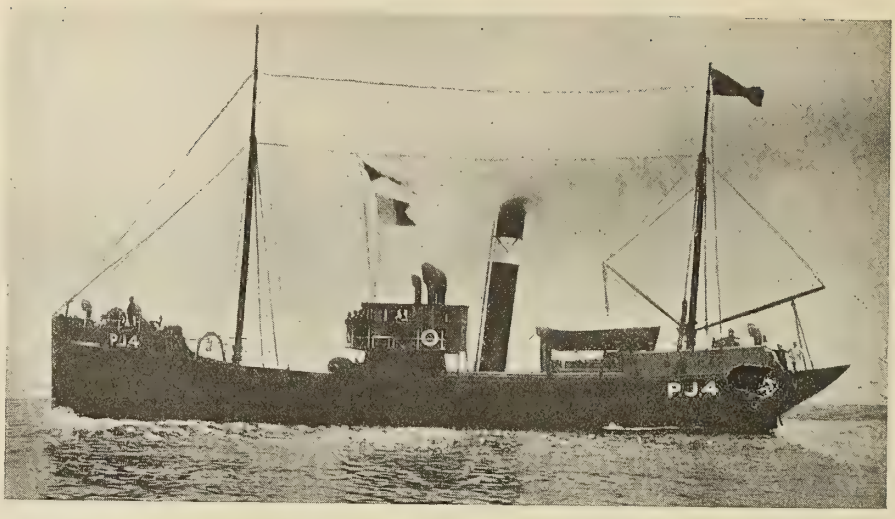


Fig. 5.—N. S. W. Government Trawler, S. S. *Goonamber*, One of Four Similar Vessels Constructed at Walsh Island, Newcastle

Another of the successful attempts at this yard was the construction of four steel trawlers for the State Trawling Industry. The trawlers were entirely satisfactory on their trials and proved equal to the best of the British type. Great delay in obtaining boilers held up the delivery of the trawlers for many months, but with the filling of this shortage, they were rapidly completed.

The boats are typical deep-sea trawlers, having raised quarter decks and forecastle heads forward and with the following details of construction:

Length overall	126 feet 3 inches
Length between perpendiculars	117 feet 0 inches
Molded beam	22 feet 0 inches
Mean depth	11 feet 6 inches
Displacement	438 tons
Speed	10 knots
Indicated horsepower	400

The machinery is aft, while the coal bunkers and boiler feed water tank are amidships. Forward of the tank and bunkers is a large insulated hold for storing fish. This hold is kept packed with ice from the first catch until port is reached. The hold is fitted throughout with vertical and horizontal divisions made interchangeable for convenience. Two of the vessels are provided with refrigerating machinery, which will adequately preserve 65 tons of fish. Above the fish holds on the well deck are the ponds, utilized for sorting the catch after the pocket of the trawler net has been emptied onto the deck. These ponds are formed by stout wooden divisions eighteen inches deep, held in place by cast-iron brackets attached to the deck.

The trawling appliances include the trawl winch, for winding in and out the drag ropes or warps, the deck fairleads for the warps, consisting of single and triple bollards, the gallows from which the otter boards are suspended when raising or lowering the net and all other necessary cleats, ring bolts, etc. Duplicate fittings are provided on each side of the vessel so that trawling may be accomplished from either quarter.

The trawl winch, a machine of special type evolved to meet the requirements of the operation, is provided with two large barrels, one for each drag rope or warp, with small drums on either side for final hoisting of the net aboard, as well as pulling the drag ropes sideways to allow their attachment to the towing block. Two single cylinder engines supply power to the winch. With 1,000 fathoms of 2½-inch steel wire rope out, the maximum trawling speed is five knots.

The propelling machinery, built at Walsh Island, consists of a set of triple expansion engines having cylinder diameters of 12, 19 and 32 inches and a stroke of 24 inches. A Babcock & Wilcox boiler supplies steam at 180 pounds pressure.

Accommodation is provided in these vessels for a compliment of fourteen men. The master's cabin is amidships, under the wheel house; the chief engineer and mate are in cabins on the upper deck amediately abaft the engine room casing, while aft of their cabins are the officers' mess and the galley. Under the after deck house and on the lower deck are two cabins for the second engineer and boatswain, a pantry and the crew's mess-room with two spare berths. The crew, including deckhands and firemen, are accommodated in the forecastle on the upper deck. All of the vessels are electrically lighted and equipped for wireless outfits.

The successful completion of these ships and the immediate prospect of even greater accomplishments have given all members of the Government and engineers of Australia a sound basis for attempting to supply the vessels required in her service. With the development of rolling mills capable of supplying ship plates and the possibility of rapid yard expansion for greater contracts, the commonwealth will go far toward realizing her ambition.

War-Time Changes in Swedish Merchant Marine

According to official information from the ship registry division of the Royal Department of Commerce of Sweden, the Swedish merchant marine comprised the following number of ships and tonnage at the periods shown below:

SWEDISH MERCHANT MARINE

	Steamships		Sailing Vessels		Motor Vessels	
Date	Number	Gross Tonnage	Number	Gross Tonnage	Number	Gross Tonnage
July 1, 1913.	1,295	993,205	1,499	178,548	110	10,020
Jan. 1, 1914.	1,307	1,019,921	1,478	176,799	119	15,020
July 1, 1914.	1,311	1,031,856	1,464	175,597	125	22,764
Jan. 1, 1915.	1,321	1,053,787	1,455	174,162	129	26,676
July 1, 1915.	1,355	1,007,841	1,416	171,621	162	32,661
July 1, 1917.	1,251	871,842	1,122	133,549	338	51,452
Jan. 1, 1919.	1,209	847,654	1,079	124,372	396	77,430

From the above figures it will be seen that the Swedish merchant marine decreased from July, 1914, to January, 1919, by 102 steamships of 184,202 gross tons, and 385 sailing vessels of 51,225 gross tons. The motor vessels, on the other hand, show an increase of 271 vessels of 54,666 gross tons. Thus, the total decrease is 216 vessels of 146,611 calculated gross tons (to the actual tonnage of the steamships and motor vessels has been added one-third of the actual tonnage of the sailing vessels). As compared with the situation before the war, the decrease in tonnage is 13.2 percent on the gross tonnage. Thus the Swedish merchant marine is now about one-seventh less than at the outbreak of the war.

100-Foot Wooden Harbor Tug Boats Building at the Plant of Consolidated Shipbuilding Corporation

THROUGH the courtesy of the Emergency Fleet Corporation and the Consolidated Shipbuilding Corporation, formerly known as the Gas Engine & Power Company, and Charles L. Seabury & Company, Consolidated, Morris Heights, N. Y., we are enabled to describe the 100-foot wooden harbor tugs building for the United States Shipping Board.

The Consolidated Shipbuilding Corporation has four of these tugs under construction and will complete its contract sometime during this summer. These small tugs were designed for hard service, and they are, consequently, of very heavy and massive construction. For the handling of the heavy timber used in their construction, this company installed a large lumber derrick to facilitate the swinging of frames, deadwood, knees, planking, etc., into position. The added equipment of the Consolidated Shipbuilding Corporation, since the outbreak of the war in 1917 has transformed the plant from one capable of building small craft and medium-sized yachts to one which is now well equipped and capable of handling large trading ships, tow boats or tugs, either steam or motor driven.

General Arrangement of the Tugs

J. Murray Watts, naval architect, Philadelphia, Pa., is the designer of these boats. Their lines are similar to the usual harbor tug of 100 feet in length with wooden deck house and pilot house. The deck house contains a companionway to the forecastle, ice box, galley and mess room, lamp locker, two staterooms and upper fire and engine rooms. The pilot house and captain's room are on top of the deck house. The crew has quarters under the forward deck in the forecastle.

Feed tanks are located forward under the forecastle and aft of the engine room. Athwartship bunkers are located between the fireroom and engine room, and wing bunkers are located at the sides of the fireroom.

Construction

The boats are built in accordance with the American Bureau of Shipping rules and are of wood throughout to the following specifications:

Keel: To be of white oak, sided 12 inches and molded 13 inches.

Stem: To be of white oak, sided 11 inches and molded 14 inches.

Stern post: To be of white oak, sided 11 inches at the keel.

Frames: To be of white oak, sided 6 inches double.

Keelson: To be 12 inches by 12 inches yellow pine in long lengths with scarfs not less than 6 feet long.

Sister keelsons: To be of 10 inches by 12 inches yellow pine.

Shaft log: To be of white oak in halves, 10 by 24 inches.

Deadwoods: To be of white oak, sided 18 inches and molded back to receive the frames.

Bottom ceiling: To be of yellow pine 3 inches thick.

Side ceiling: Ceiling between the bilge strakes and the clamps to be 3¼-inch yellow pine.

Clamps: To be yellow pine 6 inches by 10 inches, three strakes on each side in long lengths, scarfed.

Shelf: To be of yellow pine, two strakes 5 inches by 9 inches, lock strake 5 inches by 10 inches locked in beam 1 inch.

Deck beams: Main beams yellow pine sided 11 inches, and regular beams sided 8½ inches.

Knees: To be of white oak, or hackmatack.

Outside planking: Side and bilge planking to be 3¼ inches by 8 inches yellow pine.

Sheer strakes: Three sheer strakes 4 inches by 10 inches yellow pine and fastened with 7/16-inch by 8-inch galvanized spikes.

Deck planking: To be of 3-inch by 3-inch Douglas fir or yellow pine.

Plank sheer: To be of white oak 4 inches by 14 inches, let down over the stanchions and fastened with 7/16-inch by 8-inch galvanized spikes.

Rudder: The rudder stock and main piece to be of the best steel casting; blade and balance to be of oak.

Shoe: Cast steel shoe for rudder.

Water tanks: To be either stock steel tanks or independent wood tanks, as preferred.

Steel bunker bulkheads: Non-watertight steel bunker bulkheads; steel bulkhead forward of boiler, fitted as shown on plans.

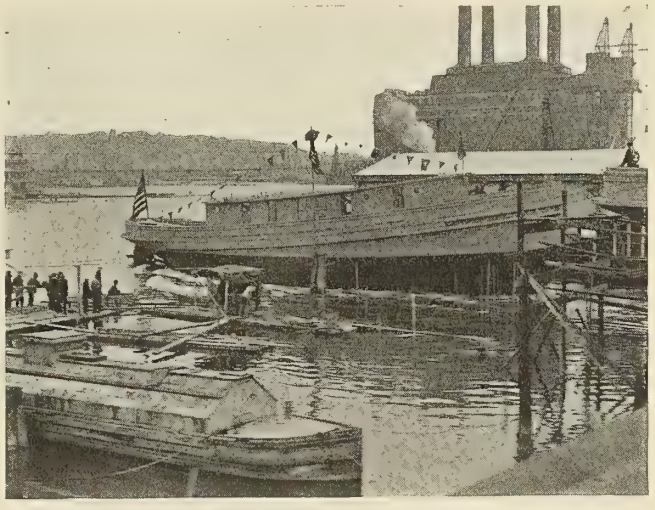
Outboard joiner work: The entire hull, decks and rails to be well planed off smooth and fair and finished ready for painting.

Wood deck house: To be of yellow pine. Top of deck house to be of Oregon pine, felted and covered with No. 6 canvas.

Pilot house: To be of yellow pine.

Machinery

Propulsion is by an inverted compound engine with cylinders 18 inches and 38 inches diameter by 26 inches stroke supplied with steam at 155 pounds pressure by a single end Scotch boiler 14 feet 6 inches diameter, 12 feet long, having 2,500 square feet of heating surface and 75 square feet of grate area. The engine is manufactured by the Consolidated Shipbuilding Corporation, and this company is also manufacturing the engines for the other tugs building at the plant.



Launching 100-Foot Tug at Yard of Consolidated Shipbuilding Corporation

The construction of the six vessels in the yards of the Consolidated Shipbuilding Corporation is not only under the supervision of their own superintendent and his assistants, but also under the surveillance of Emergency Fleet inspectors, who look after the Government's interests in the inspection of workmanship and materials.

Investigation Into Bulkhead Stiffeners

Stresses Figured in Accordance with Rules of Classification Society—Only Clipped and Free-Ended Stiffeners Considered

BY A SPECIAL CORRESPONDENT

THE following data and stresses have been figured for a bulkhead designed in accordance with the rules of one of the largest classification societies. Only clipped and free-ended stiffeners have been considered, as it is the intention to investigate bracketed stiffeners at a later time. In this connection, however, it might be said that from the data already collected it appears to the writer that entirely too much credit is given to the end fixing ability of brackets.

Nothing original is claimed for the following figures, but it is thought that this is the first attempt made to collect these data into a form which would permit publication. Much of the theoretical data has been taken from Professor Hovgaard's papers on "Strength of Bulkheads," read before the Society of Naval Architects and Marine Engineers in 1910 and 1911.

The figures assumed for the bulkhead considered are not unusual and it would be possible to find special conditions which would develop greater stresses than those obtained from the assumed conditions.

The bulkhead considered is shown in the sketch, Fig. 1, and has the dimensions shown on the figure. All the calculations are given in detail, because, while not necessary to the older men in the profession, it is hoped that they will make this paper more valuable and interesting to the large number of new draftsmen just entering this profession and possibly form a guide for their efforts.

The classification societies admit two classes of bulkheads, i. e., ordinary structural bulkheads which are subjected to stress only at times of an accident, and those which form the boundaries to trim tank or deep ballast tanks which are subjected to pressure at regular intervals. The former class is subdivided into bulkheads for cargo vessels and bulkheads for passenger vessels. In the latter, it will be seen the stresses are less than in cargo bulkheads. Each of these classes will be considered in this paper. Three types of stiffeners are tabulated, i. e., no end attachments, clipped at ends, and bracketed. The two former classes are considered in the following data.

By referring to the rules, we find that the elements considered in determining the size of stiffeners are: (1) length, (2) spacing, (3) head, and (4) type of end connections. All of these elements are also the terms employed in figuring the bending moment. It is therefore seen that this is a scientific method of determining scantlings. The only term which is not considered in its full value, and this only in the case of the first type of bulkheads, is the actual head. However, in deep tank bulkheads this is adequately considered.

From Fig. 1 we obtain the following data:

L = length of stiffeners, lower section, = 12 feet.
S = spacing of stiffeners = 2 feet 6 inches.
H' = head to load waterline = 6 feet.
H = head to bulkhead or strength deck = 7 feet 6 inches.

These data are sufficient to enter the rules. We will first consider the stiffeners with no end attachments, and in this discussion bulb angle stiffeners only have been considered.

With this value of head and L = 12 feet, we can enter the tables.

From the above data we see from the tables of bulb angle stiffeners that an 8-inch by 3-inch by .42-inch bulb angle is required. Such a section, however, is not obtainable in this country, so we take the nearest section obtainable, which is an 8-inch by 3-inch by .425-inch bulb angle, having the following characteristics:

Area	5.30 square inches
Moment of inertia	42.9 inch units

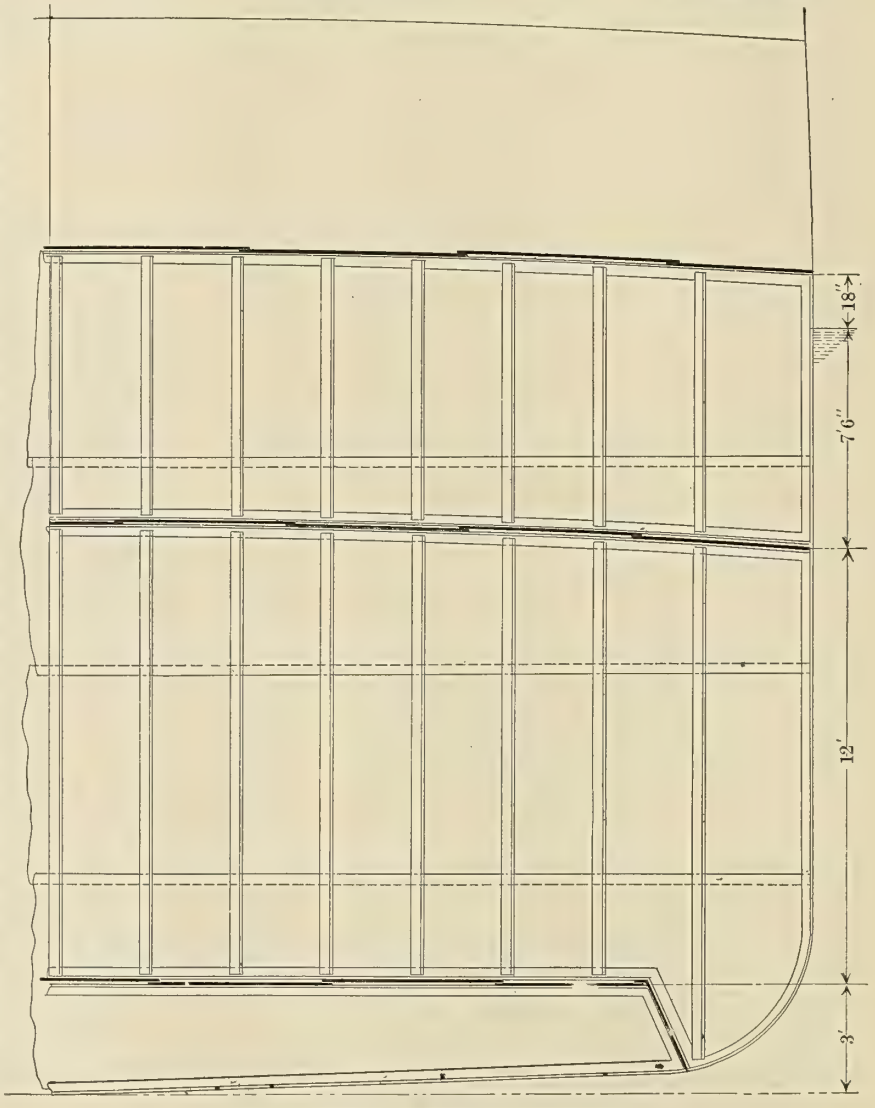


Fig. 1.—Sketch of Bulkhead Considered

Section modulus	10.0 inch units
Neutral axis from bulb	4.30 inches
Neutral axis from heel	3.70 inches
Weight per foot of length	18.0 pounds

To obtain the stresses, we must figure the maximum bending moment and the section modulus of stiffener and strip of bulkhead plating acting with it. The ends are free to change slope, so our bending moment, using Professor Hovgaard's notation, is:

$$M = .126\ Pl.$$

Where P is load and

l = length in feet.

P, we find for a combined uniform and uniformly increasing load, is:

$$P = Wslh + \frac{wsl^2}{2},$$

where the first term is the uniform load and the second the varying load. The terms of this formula have the following meaning:

W = weight of water per cubic foot.
s = frame spacing in feet.
l = length of stiffener in feet.
h = head at top of stiffener in feet.

Solving this equation, we get:

$$P = 64 \times 2.5 \times 12 \times 7.5 + \frac{64 \times 2.5 \times 12 \times 12}{2}.$$

$P = 14{,}400 + 11{,}520.$
$P = 25{,}920$ pounds.

In this case h, the head, has been taken to the bulkhead deck. This is probably the greatest head the bulkhead will be subjected to, if the vessel remains afloat after damage.

From this value of P, we get for the bending moment: $M = .126 \times 25{,}920 \times 12 = 39{,}191$ foot pounds, and in inch unit terms $M = 470{,}292$ inch pounds.

This, of course, acts at about the middle length of the stiffener.

In figuring the stress in the extreme fibers of the stiffener, it is necessary to find the section modulus of the combined stiffener and bulkhead plating. It is assumed that a strip of the bulkhead plating with a width of twenty times the thickness is acting with the bulb angle stiffener. This is considered to be a reasonable assumption. However, as a matter of interest, other widths are considered in the following figures:

Fig. 2 shows the stiffener and its functional strip of plating, and from this we figure two new characteristics as follows:

The plating is taken at .32 inch, which is in accordance with the rules.

Width of plating is taken as 20 t

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	2.04	8.16	16.65
Stiffener	5.30	4.30	22.79
Sum	7.34	5.37	39.44

It is now necessary to find the moment of inertia about this new neutral axis.

Taking first the plate, the moment of inertia about its own axis is given by

$$\frac{1}{12} Ad^2, \text{ or } \frac{2.04 \times .32^2}{12} = .0174\text{-inch units.}$$

To find the moment of inertia about the new axis, we use the principle that $I_0 = I + Ad^2$, where d = distance of transference, or, in other words, the distance between the two neutral axes. Then $I_0 = .0174\ (2.04 \times 2.79^2) = .0174 + 15.99 = 16.01$ inch units.

The distance 2.79 in the above equation is found as follows:

8.00 inches — 5.37 inches = 2.63 inches distance of neutral axis from heel of angle; then 2.63 inches + .16 inches (neutral axis of plate from heel) = 2.79 inches.

Taking now the bulb angle, we have for the new moment:

$$I_0 = I + Ad^2 = 42.9 + [5.3 \times (5.37 - 4.30)^2] = 42.9 + (5.3 \times 1.12) = 48.84\text{-inch units.}$$

Total $I_0 = 16.01 + 48.84 = 64.85$-inch units.

Then section modulus is

$$\frac{I}{y} = \frac{64.85}{5.37} = 12.10\text{-inch units.}$$

We can now find the maximum stress at the extreme fibre. Assume the pressure on the calking side of the

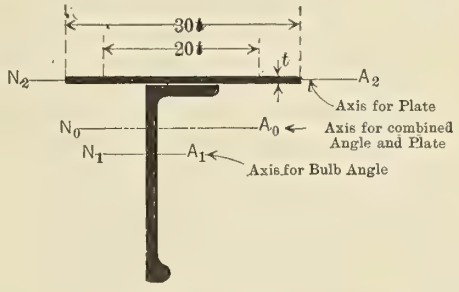


Fig. 2.—Stiffener and Plating

bulkhead. This throws the outer edge of the bulb angle into extension and the amount of this force is as follows: f being stress, M being bending moment and S section modulus, all in inch units, then

$$f_t = \frac{M}{S} = \frac{470{,}292}{12.10} = 38{,}859 \text{ pounds per square inch.}$$

The compression in the plating is

$$f = \frac{My}{I} = \frac{470{,}292 \times (8.32 - 5.37)}{64.85} = 21{,}466 \text{ pounds per square inch.}$$

If, however, the pressure is on the non-calking side of bulkhead, the plating is in tension and this stress will be reversed.

The assumption of the width of the plating acting with the stiffener is moderate. Suppose we assume this width to be increased to 30 t; then the neutral axis and section modulus calculations will be as outlined below.

To find the neutral axis:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	8.16	25.05
Stiffener	5.30	4.30	22.79
Sum	8.37	5.84	48.84

$$I \text{ of plate} = \frac{3.07 \times .32^2}{12} = .0262.$$

I_0 of plate $= .026 + [3.07 \times (8.00 - 5.84 .16)^2] = .026 + 16.50 = 16.54$-inch units.

I_0 of stiffener $= 42.90 + [5.3 \times (5.84 - 4.30)^2] = 42.90 + 12.56 = 55.46.$

Total $I_0 = 16.54 + 55.46 = 72.00$-inch units.

Then $S = \frac{72.00}{5.84} = 12.33$-inch units.

With the pressure on the calking side, we get:

$$f_t = \frac{470{,}292}{12.33} = 38{,}142 \text{ pounds per square inch.}$$

$$f_c = \frac{470{,}292 \times (8.32 - 5.84)}{72.00} = 16{,}199 \text{ pounds per square inch.}$$

We thus see that with a width of thirty times the thickness the stresses in the plating are slightly greater, and if a still wider strip were considered, the stress in the angle would decrease. It would not be safe, however, to assume any greater width of plating unless its thickness were increased, since buckling will occur at slightly increased stresses over those found.

The most important thing about these figures to notice is that the stress in this condition is beyond the elastic limit of the material, and if the element of bulkhead plating is not figured the stress would be far beyond the elastic limit. To prove this, assume that the stiffener acts alone. Then

$$f = \frac{470{,}292}{10.0} = 47{,}029 \text{ pounds per square inch.}$$

In view of this, it would be wise to show on the bulkhead plans ample riveting strength between plating and stiffener and to insist upon good workmanship, i. e., fair holes and sound, well-driven rivets, because otherwise the plating and stiffener will not act together.

It will be shown later that the functional strip of plating is more important in reducing the stress in a stiffener than the clips at the ends of clipped stiffeners.

Also in this connection it is to be noted that the plating should, if possible, be placed so that it carries compression, because then the water pressure tends to force the plating into closer contact with the stiffeners. The rivet spacing should not be too great, since there is a tendency for the plating, when in compression, to buckle away from the stiffener between the rivets.

As noted above, the stress in the stiffeners is beyond the elastic limit, and even in the nature of the construction this should not be permissible. This bulkhead is one of the class which will seldom, if ever, be called upon to withstand pressure, because it is intended only to subdivide the ship into compartments, which will only be flooded when in collision or at times of accident. It should, however, be capable of withstanding this pressure when called upon. The head has been taken up to the bulkhead deck, and it might be argued that when one compartment is flooded the new waterline will still be below this deck level. This is true, if too much change in trim does not occur, but still another point to be considered is that when the tank is flooded to a level below this deck level dynamic stresses would arise, due to the motion of the ship in a seaway. The combination of static and dynamic stresses in this case exceeds those figured for the maximum liable static head, as already done.

It has been pointed out above that the connection between the plating and stiffener is very important, and in view of this it is proper to investigate this riveting. The rules call for ¾-inch diameter rivets spaced seven diameters, or 5¼ inches on centers. We will figure the horizontal shear at a point 2 feet from the bottom of the stiffener and get the vertical shear in the rivets at this point:

$$\text{Shear force } F = \frac{Wshl}{2} + \frac{2Wsl^2}{6} = \frac{64 \times 2.5 \times 7.5 \times 10}{2} + \frac{2 \times 64 \times 2.5 \times 100}{6} = 6{,}000 + 5{,}333 = 11{,}333 \text{ pounds.}$$

Then since $q = \frac{F}{I} my$

where q = shear stress in pounds per inch.
I = Moment of inertia.
m = area above section at which shear is to be found.
y = distance of center of gravity of area to neutral axis.

$$q = \frac{11{,}333}{72.0} \times \text{area functional plate} \times \text{distance c. g. of plate to neutral axis.}$$
$$= 157.4 \times 3.07 \times (2.16 + .16).$$
$$= 1119.7 \text{ pounds per inch of depth.}$$

The stress per rivet is $1119.7 \times 5.25 = 5{,}878$ pounds.

Then stress per square inch of rivet is $\frac{5{,}878}{.442} = 13{,}300$ pounds.

This stress is considered too high and the pitch should be reduced, especially as it has been shown that the functional plating reduces the stress in the stiffener considerably.

We will now consider clipped stiffeners for this same bulkhead. The construction in this case consists of fitting double angle clips at the base and head of the stiffeners, which tend to hold them up to their work. The riveting

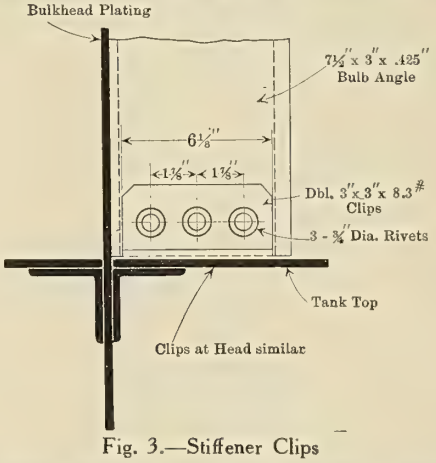


Fig. 3.—Stiffener Clips

for these clips is fixed by the rules and the required construction is shown in Fig. 3.

As will be seen, the classification rules permit a reduction in the stiffener in this case of 15 percent. This reduction, to the writer's mind, is rather generous. Of course, it must be borne in mind that it is possible very nearly to fix the ends of the stiffeners by clips, if the necessary riveting strength is introduced. Before further considering the end connections of these stiffeners, we will obtain the required scantlings from the rules.

In this case we proceed as before and find from the table that the required stiffener would be a 7½-inch by 3-inch by .425-inch bulb angle with the following characteristics:

Area	5.02 square inches.
Moment of inertia	35.70-inch units.
Section modulus	8.80-inch units.
Neutral axis from bulb	4.08 inches.
Neutral axis from heel	3.42 inches.
Weight per foot of length	17.1 pounds.

The weight of plating will be the same as in the case just considered, so we can proceed as before to find the section modulus of angle and plate, when acting together. The width of plating has been taken as thirty times the thickness. The figures are as follows:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	7.66	23.52
Stiffener	5.02	4.08	20.48
Sum	8.09	5.44	44.00

$$I \text{ of plate} = \frac{3.07 \times .32^2}{12} = .0262\text{-inch units.}$$

$$I_o \text{ of plate} = .03 + [3.07 \times (7.5 - 5.44 + .16)^2] = .03 + 15.14 = 15.17\text{-inch units.}$$

$$I_o \text{ of stiffener} = 35.70 + [5.02 \times (5.44 - 4.08)^2] = 35.70 + 9.29 = 44.99.$$

$$\text{Total } I_o = 15.17 + 44.99 = 60.16\text{-inch units.}$$

$$\text{Then } S = \frac{60.16}{5.44} = 11.05\text{-inch units.}$$

We will now consider the end connections. The rules call for three ¾-inch diameter rivets in the clips. The figures for these clips will be about as shown on Fig. 3. The polar moment of inertia of these rivets will be as follows, using the figures shown on the sketch:

$$I_p = Ay^2 \times 2 = .442 \times 2 \times 1.88^2 = 3.12\text{-inch units.}$$

Now the problem is to find how much bending these clips will take. This will, of course, not be equal to the bending moments at the ends, if the stiffener is considered fixed, but will be a proportion of the same.

The allowable stress in the rivets through the clips when considering bending only should not exceed 15,000 pounds per square inch. This then gives as the allowable bending moment at the end:

$$M = \frac{fI_p}{y} = \frac{15{,}000 \times 3.12}{1.88} = 24{,}900\text{-inch pounds.}$$

If this stiffener were fixed at the ends, the bending moment at the lower end, due to the head, would be, using again Professor Hovgaard's notation:

$M_b = .092\ Pl$, which gives
$M_b = .092 \times 25{,}920 \times 12 = 28{,}016$ foot pounds.
$= 336{,}192$-inch pounds.

The bending moment at the head of the stiffener would be:

$M_h = .075\ Pl$, which gives
$M_h = .075 \times 25{,}920 \times 12 = 23{,}328$ foot pounds.
$= 279{,}936$-inch pounds.

Note now that the bending moment which can be taken by the clips bears the following ratio to that actually existing at the ends, if they were fixed:

$$\text{At bottom } \frac{24{,}900}{343{,}200} = 7.26 \text{ percent.}$$

$$\text{At top } \frac{24{,}900}{279{,}936} = 8.91 \text{ percent.}$$

If this stiffener were fixed at the ends, the bending moment would be at 6.24 feet from top and has been found to be 470,292 inch pounds. With the ends clipped, as in this case, the maximum bending moment is about at the same point and is equal to 470,292 — 24,900 = 445,392 inch pounds.

This gives us a stress in the stiffener, as follows:

$$f = \frac{M}{S} = \frac{455{,}392}{11.05} = 41{,}212 \text{ pounds per square inch.}$$

The stress in the plating is

$$f = \frac{My}{I} = \frac{445{,}392 \times (7.5 + .32 - 5.44)}{60.16} = 17{,}619 \text{ pounds per square inch.}$$

The above stresses are higher than those obtained for free-ended stiffeners. The stress in the stiffeuer is too high for safety, even when it is realized that this bulkhead may only once be called upon to withstand this pressure. The failure at this time may mean the loss of the vessel and endanger the lives of the crew.

The percentage increase in stress is, in the case of the stiffener:

$$\frac{41.212}{38{,}142} = 1.082, \text{ or } 8.2 \text{ percent increase, and in the plating}$$

$$\frac{17{,}619}{16{,}199} = 1.089, \text{ or } 8.9 \text{ percent increase.}$$

As noted before, the rules allow a reduction in scantling of about 15 percent.

The decrease in bending moment, as figured above, is

$$\frac{470{,}292}{445{,}392} = 1.056, \text{ or } 5.6 \text{ percent decrease.}$$

If no credit is given to the end clips on the stiffeners, the stress in the stiffener would be:

$$f = \frac{470{,}292}{11.05} = 42{,}560 \text{ pounds per square inch.}$$

The above figure shows that it is necessary to have very good workmanship on the clips, securing the stiffener ends, if stresses far beyond the elastic limit are to be avoided. It is especially imperative to have good, fair rivet holes and well-driven rivets, or slip will occur. The slip, even if very slight, would take the stiffener out of the partially fixed type and put it into the free ends type, thereby, as shown above, increasing the already high stress by

$$\frac{42{,}560}{41{,}212} = 1.033, \text{ or } 3.3 \text{ percent.}$$

If the functional plating is neglected, the stress in the stiffeners is

$$f = \frac{445{,}392}{8.80} = 50{,}612 \text{ pounds per square inch.}$$

If the effect of the clips is neglected as well as the functional plating, we get the following stress:

$$f = \frac{470{,}292}{8.80} = 53{,}442 \text{ pounds per square inch.}$$

The clips themselves should be of such a weight as not to distort when stressed, and where the deck or tank top plating is under 15 pounds per square foot local doubling plates should be fitted to secure rigidity and avoid deflection at supports.

The bending stress in the plating cannot be determined easily, but a check on the strength can be made as follows:

At mid-height this plating has a thickness of .32 inch. Assume the plate freely supported between the heel of

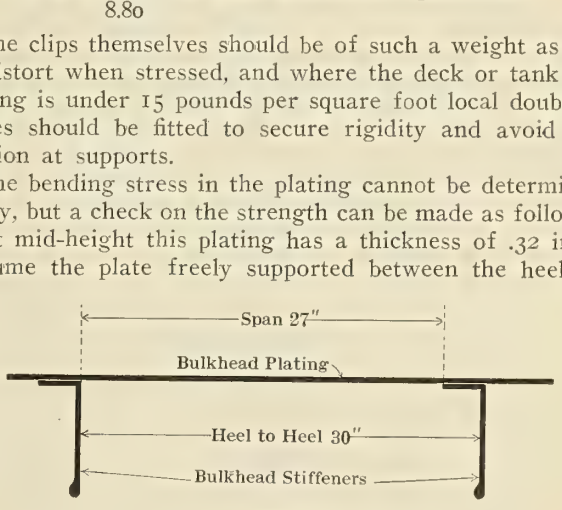


Fig. 4

one and toe of the adjoining stiffener (see Fig. 4). Then bending moment is given by

$$M = \tfrac{1}{8}\ Wl.$$

Where W will be the load on a strip of plating 27 inches long and 1 inch wide, due to a head of 13.5 feet. This gives $W = 5.94 \times 27$, where 5.94 is the pressure in pounds per square inch due to the head. Then the bending moment is

$$M = \frac{5.94 \times 27 \times 27}{8} = 541\text{-inch pounds.}$$

The moment of inertia of the plate is

$$I = 1/12\ (.32 \times 1 \times .32^2) = .00273\text{-inch units.}$$

$$\text{Then } f = \frac{541 \times .16}{.00273} = 31{,}707 \text{ pounds per square inch.}$$

From this figure it can be seen that, while high, the corresponding deflection will not be so great as to destroy the calking, if the latter is well done.

The above method of figuring the stress in plating is only an approximation and is valuable as a guide only. The actual stress calculation is highly mathematical and of questionable accuracy.

We will now consider the shear on the rivets connecting the plating and stiffeners, due to the tendency of these two members to slip upon each other.

The shear on the rivets connecting the plating to the stiffeners two feet above the bottom is figured as follows:

Shearing force:

$$F = \frac{64 \times 2.5 \times 7.5 \times 10}{2} + \frac{2 \times 64 \times 2.5 \times 100}{6} = 6{,}000 + 5{,}333 = 11{,}333 \text{ pounds.}$$

$$q = \frac{11{,}333}{60.16} \times 3.07 \times (2.06 + .16).$$

$$q = 280 \times 10.95 = 1264.8 \text{ pounds.}$$

Riveting being as above, the stress per square inch of rivet would be:

$$\frac{1264.8 \times 5.25}{.442} = 15{,}023 \text{ pounds.}$$

This latter stress is too high for shear and shows that the rules should reduce the pitch of rivets connecting the plating to the stiffeners.

The shear on the rivets in the clips is given by

$$F \text{ at bottom support} = \frac{Wshl}{2} + \frac{2\,Wsl^2}{6}$$

$$= \frac{64 \times 2.5 \times 7.5 \times 12}{2} + \frac{2 \times 64 \times 2.5 \times 144}{6}$$

$$= 7{,}200 + 7{,}680 = 14{,}880 \text{ pounds.}$$

We have three ¾-inch rivets in double shear, so the equivalent stress for single shear would be

$$q = \frac{14{,}880}{1.8 \times 3 \times .442} = 6{,}226 \text{ pounds,}$$

if the rivets in the tank top angles are not considered. If we take two such rivets as aiding to resist the above load, we have (assuming tank top rivets as ¾-inch diameter):

$$q = \frac{14{,}880}{1.8 \times 3 \times .442 + 2 \times .442} = \frac{14{,}880}{3.27} = 4{,}550 \text{ pounds.}$$

To this must be added the stress due to bending, as found before. Some writers add the two directly, but it is, I think, wrong and the two should be added as a combined stress, i. e.,

$$P = \sqrt{q^2 + f^2}.$$

This gives:

$$P_1 = \sqrt{6226^2 + 15{,}000^2}.$$

$$P_1 = 16{,}250 \text{ pounds per square inch.}$$

It will be seen that this gives a more moderate stress than if they were simply added, i. e.,

$$15{,}000 + 6{,}226 = 21{,}226 \text{ pounds per square inch.}$$

(To be continued.)

Planing of Angles in Ship Construction for Watertight Calking

BY E. R. SPENCER*

LEAKAGE in a steel vessel is ordinarily traceable to inferior riveting or ineffective calking. Experience with some of the first steel seagoing ships to be put into service during the pressing period of war-time marine activity indicated that it was practically impossible to calk the edges of plates and the lips of angles in steel ship construction without first planing (or, as sometimes termed, beveling) the calking edge to get a clean, sharp, workable lip, free from scale. Calking has been common practice in many of the older shipyards of the country for many years. Various methods have been in practice for planing the plates and angles. The handling of plates is not as difficult as the handling of angles. The latter, when used in any quantity, presents one of the most trying problems in the structural shop, which has resulted in the installation of special machine tools to do this planing work. Angles of light section are not so difficult to handle by the average type of angle planing machine, but when it comes to planing the heavier sections, the driving power that has to be exerted on the angle as it passes through the driving rolls of the planer to accomplish the work with reasonable speed, leads to difficulty due to the tendency to warp the angle. Another difficulty that developed was to get a machine of sufficiently substantial construction, and possessing enough driving power, to handle the larger angles commonly used in present-day ship construction.

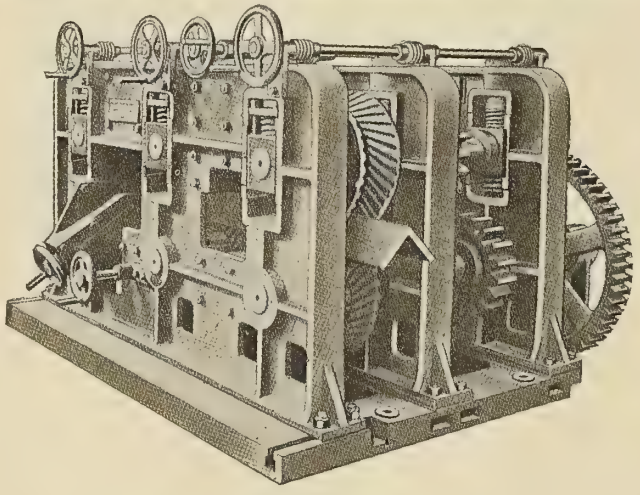


Fig. 1.—Feeding-In End of Angle Planer

This machine is designed for planing angles for ship work to permit calking. Ordinarily one pass through the machine is sufficient. The planing can be straight or to any angle desired

New Machine for the Hull Department

A machine tool that has been developed to meet the requirements dictated by service conditions is always of particular interest to the engineer and the works manager, who are called upon to get results by the most effective means at their command. Accordingly, the following description of a new type of angle planer will be of particular interest to the hull construction men and the marine engineer in the shipbuilding field.

This angle planer, on which patents are pending, performs three operations simultaneously, with three separate tools; namely, it planes the two lips of the angle passed through it, and, if required, also planes off the heel of the angle, with an independently-controlled tool for each

* Sales Engineer, Thomas Spacing Machine Company, Pittsburgh, Pa.

of the three operations. Each edge of the angle can be planed off to any shape of lip, depending upon the shape of the tool used for the cut. Planing the heel is required where one angle has to be fitted within another, in which case the fillet in the corner of the outer angle interferes with the inner angle being brought up to a close fit on both faces unless the heel of the inner angle is removed.

Special Features

A view of the feeding-in end and operating side of this planer is found in Fig. 1, while Fig. 2 shows the discharge end, with the direct geared driving motor mounted in place. These views give a good idea of the rugged, substantial construction of this machine. Many of the features of design are evident from these illustrations; others should be considered in detail, as they illustrate how the design of the machine has been developed according to service requirements.

Driving Rolls

In the first place it was determined that the proper method of driving the angle through the machine was to have all six driving rolls, three upper and three lower, arranged for power drive. Furthermore, in order to eliminate the tendency of the angle to curl in case of its being driven all on one flange, the driving rolls were made V-shaped, so that the two outer and two inner faces of the angle would all be in contact with the driving rolls under equal pressure. This necessitated rather an elaborate train of main driving gears (described below), these being machine-cut in order to assure a smooth running, efficient drive in which alinement would be maintained. It will be noted that the screw-down for the three upper driving roll shafts is carried through spiral compression springs, the compression of which is set independent of the screw-down, by means of tie bolts. With this arrangement it is difficult for the operator to put an excessive driving roll pressure on the angle, except by deliberately setting the rolls too close by means of the screw-downs. Without this feature the driving rolls are apt to act like a milling cutter, often entirely removing the manufacturer's name, which is usually rolled into the face of the angle when it is made. With the spring mounted drive the angle goes through the machine without any such grinding action, the rolls adjusting themselves automatically to variations in the thickness of the angle.

In addition to the main driving rolls, four guide rolls are provided, two upper and two lower. The outside upper roll is shown in Fig. 2 where the angle is leaving the machine.

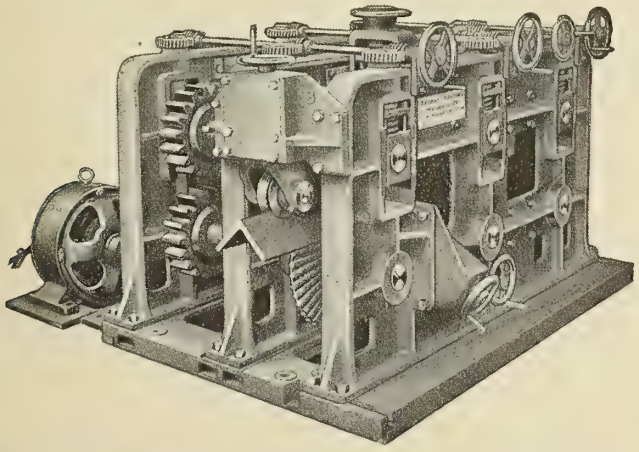


Fig. 2.—Discharge End of Angle Planer, Showing Straightening Roll

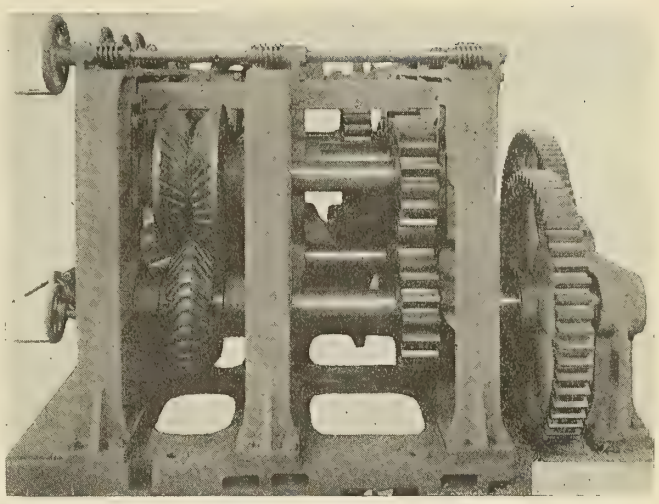


Fig. 3.—End View, Showing Details of Conical Driving Rolls, Main Driving Gear Train and Reduction Gears

This roll serves as a straightening roll, and accordingly it is provided with a separate screw-down. The inside upper guide roll, which is located between the second and third set of upper driving rolls, is also provided with a screw-down, the hand wheel of which is shown at the top of the machine in Fig. 2. The two lower guide rolls are located respectively between the first and second, and second and third, lower driving rolls, and are hung on eccentric shafts, so that their vertical position is adjustable to suit different thicknesses of the angle by releasing a set-screw. With this arrangement of adjustable guide rolls, the angle planer serves also as a straightening roll, so that the angle, when it comes out of the machine, is ready to use without its having to be handled again for straightening. To assist in starting the angle through the machine, an upper guide shoe is also provided, which is located between the first and second upper driving rolls, directly in front of the vertical tool holder above the heel of the angle. This shoe guides the entering end of the angle into the machine in the proper vertical position to start the cut on the heel before it reaches the second set of driving rolls, after which the angle is not in contact with the shoe. The details of the drive are such that the machine completely planes the single angle without having to use another to help the first one through.

How the Rolls are Set

The position of the driving rolls is indicated by gages shown in Figs. 1 and 2, on the operator's side of the machine; these permit the operator to set the screw-down correctly before the angle is passed through the machine. When once set for a given size of angle, the screw-down does not have to be changed as long as the same size of angle is being handled. Slight variations are taken care of by the safety spring, without the screws of the screw-down being subjected to undue pressure. It is interesting to note that any size of angles, from the smallest ordinarily rolled as standard up to 8 inches by 8 inches by 1 inch, can be handled in this machine by simply changing the setting of the screw-down, guide rolls, and straightening roll.

Adjustment of Cutting Speed

To handle such a range of sizes as this, adjustment of the cutting speed is required, and to provide for this it is advisable to equip the machine with an adjustable speed motor. A 25-horsepower motor with a 3 to 1 speed varia-

tion is used, the range of speeds recommended being from 400 to 1,200 revolutions per minute. This condition is met most readily by use of a direct current motor in which the speed variation is obtained by field control. With a 3 to 1 speed range, cutting speeds on the machine varying from 15 feet to 45 feet per minute are obtained. Where only alternating current power is available, a constant speed motor is used, and the gears are arranged to give a cutting speed of 25 or 30 feet per minute.

That this machine fully meets service requirements is indicated by the fact that in a service test which was conducted a year or so ago at one of the large shipyards, the largest standard size of angle, namely, 8 inches by 8 inches by 1 inch, was put through the machine at a cutting speed of 45 feet per minute, with all three cutting tools taking full cuts on the angle, without the machine showing any signs of laying down on the job. This opeating condition was continued for several hours, and the machine handled the angles as fast as they could be fed into it.

A detail view of the feeding-in end of the machine is shown in Fig 3, in which are to be seen the first upper and lower conical driving rolls, the train of main driving roll gears and shafts, and the train of reduction gears from the motor to the first main drive shaft. In order that each set of upper driving rolls shall ride independently on the angle through the spring-mounted screw-down previously described, it is necessary that the three roll shafts be interconnected by idler gears. The lower roll shafts are geared together with the same arrangement of idlers, and each pair of upper and lower idlers mesh together. The last, or low speed, spur gear of the gear reduction outside the outboard housing is keyed onto the extension of the first lower driving roll shaft, as shown in Fig. 3. With this arrangement all six driving rolls are power-driven, with the gears in proper mesh regardless of the setting of the rolls for different sizes and varying thicknesses of angles.

The screw-down on each upper outboard bearing is kept in vertical alinement with the other two bearings by means of a compression spring under the journal box. One of these springs is shown at the right in Fig. 1. Bending of the shaft is thus practically eliminated. This layout has proved to be most satisfactory under all conditions of operation.

It will be noted by reference to Figs. 1 and 2 that the various adjustments and controls for the setting of the driving and straightening rolls, as well as the gages and the hand wheels for controlling the cutting tools, are all within convenient reach of the operator on the operating side of the machine. It is also advisable that the motor controller be located within easy reach.

It will be seen from the illustration that the base casting of the machine is arranged so that the outer housing on the operator's side can be slid out beyond the end of the roll shafts, without being removed from the base of the machine. This arangement gives easy access to the upper and lower driving rolls, in case it is desired to smooth them up without removing them from the shaft, or for taking them off in order to replace them with new rolls. All bearings are provided with sight feed oil cups, so that the operator can see to the proper oiling of the bearings without the necessity of having to stop the machine on this account.

The capacity of this machine for handling all sizes of angles, without the necessity of any change of set-up for different sizes and thicknesses of angles, except the adjustments for which the machine is arranged and which are easily and quickly made, makes this angle planer suitable for handling all work in the average shipyard; and with the output that it is possible to obtain, one machine is all that is required, unless the installation of two machines is dictated by the plant lay-out to obviate the necessity of transferring material from one location to another, as would be required in a large shipyard where all of the angles to be planed would have to pass through one machine.

Marine Terminals as Municipal Investments

Reports from Sydney Harbor Trust from 1901 to 1918 Show Working Expenses 26.19 Percent of Gross Receipts—Even Better Results Possible

BY H. MCL. HARDING*

BONDS issued by cities for the improvement of port terminals are in the same class as water bonds, inasmuch as such terminals can earn the interest on the bonds and provide for maintenance, amortization and working expenses, and in addition leave a surplus for further waterfront improvements.

This has been clearly demonstrated at foreign ports, among which is the port of Liverpool. It is, however, preferable to take as examples port terminals which are similar to what American terminals would become under like circumstances, such as the duration of the terminal existence, density of population, language and methods of operation, and especially what has been the experience under the late war conditions. It is desirable to know what would be the effect of a war on a port terminal investment.

English Colonial Ports

Fortunately we have English colonies, the ports of which may be studied to advantage, which are of comparatively recent origin and which have just passed through a war never before equaled as to its strain on financial resources, stoppage of shipping and severity of operating conditions, the last due to labor strikes and other difficulties.

Among these colonial ports may be mentioned the Port of Sydney, New South Wales, Australia, as an example. Its records, data and the financial results from its inception in 1901 to June, 1918, are of great value as a forecast of what may be expected in the development of most American ports in respect to gross and net revenues, proportional capital expenditures, wharfage and other rates, renewals and replacements, wharves, sheds and warehouses, tonnage and berthing, and transshipment. These records are indicated upon charts year by year from June, 1901, to June, 1918, and a combined diagram for all these years is shown in Fig. 2.

Revenue and Expenditures at Port of Sydney

The following figures, more in detail, are from June, 1917, to June, 1918, and include the dark period of the

* Consulting terminal engineer, New York.

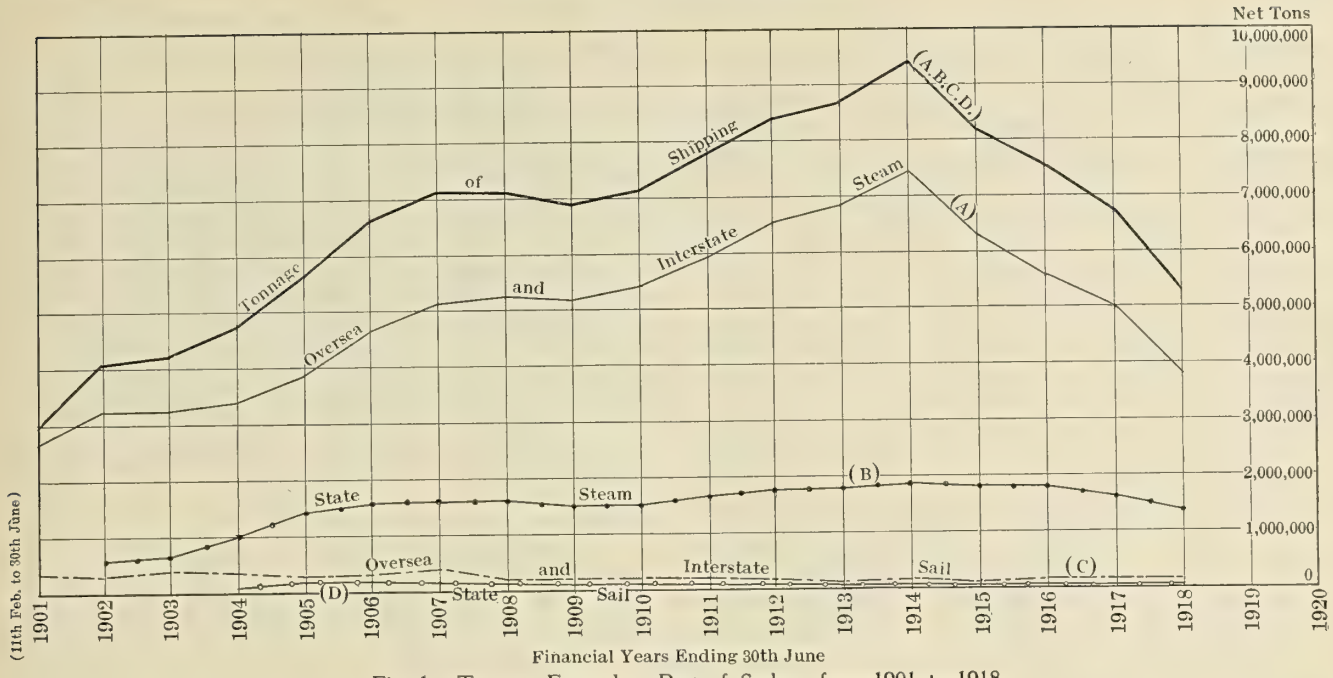


Fig. 1.—Tonnage Entered at Port of Sydney from 1901 to 1918

great war. The figures are so complete that they should be of instructive value to all American port authorities.

The revenue collected during the last year to June, 1918, amounted to $2,820,000 (£576,459 3s. 8d.). Working expenditures, including salaries, amounted to $740,000 (£151,016 15s. 4d.), or only 26.19 percent of the above gross income. Renewals and replacements amounted to $94,600 (£19,387 4s. 9d.).

The surplus for the year's transactions after deducting $94,600 (£19,837 4s. 9d.) amounted to $282,000 (£57,583 5s. 9d.). The gross revenue was 6.68 percent on capital, and the net revenue, 4.89 percent.

The above figures indicate a satisfactory year from the revenue point of view, even though it was under war conditions and there was a long strike period. It was found necessary, due to the war, to increase the wharfage rates somewhat. The number of vessels entering the port during the year ending June 30, 1918, was 7,535, with a gross registered tonnage of 9,058,568 and a net tonnage of 5,320,400. The goods imported amounted to 3,447,656 tons. The value of imports into Sydney was $270,000,000 (£55,371,749), and of exports, $177,000,000 (£36,289,589). There was expended in completion of works which had been commenced before the war $1,025,000 (£209,851).

Figures are available giving in detail all of the above

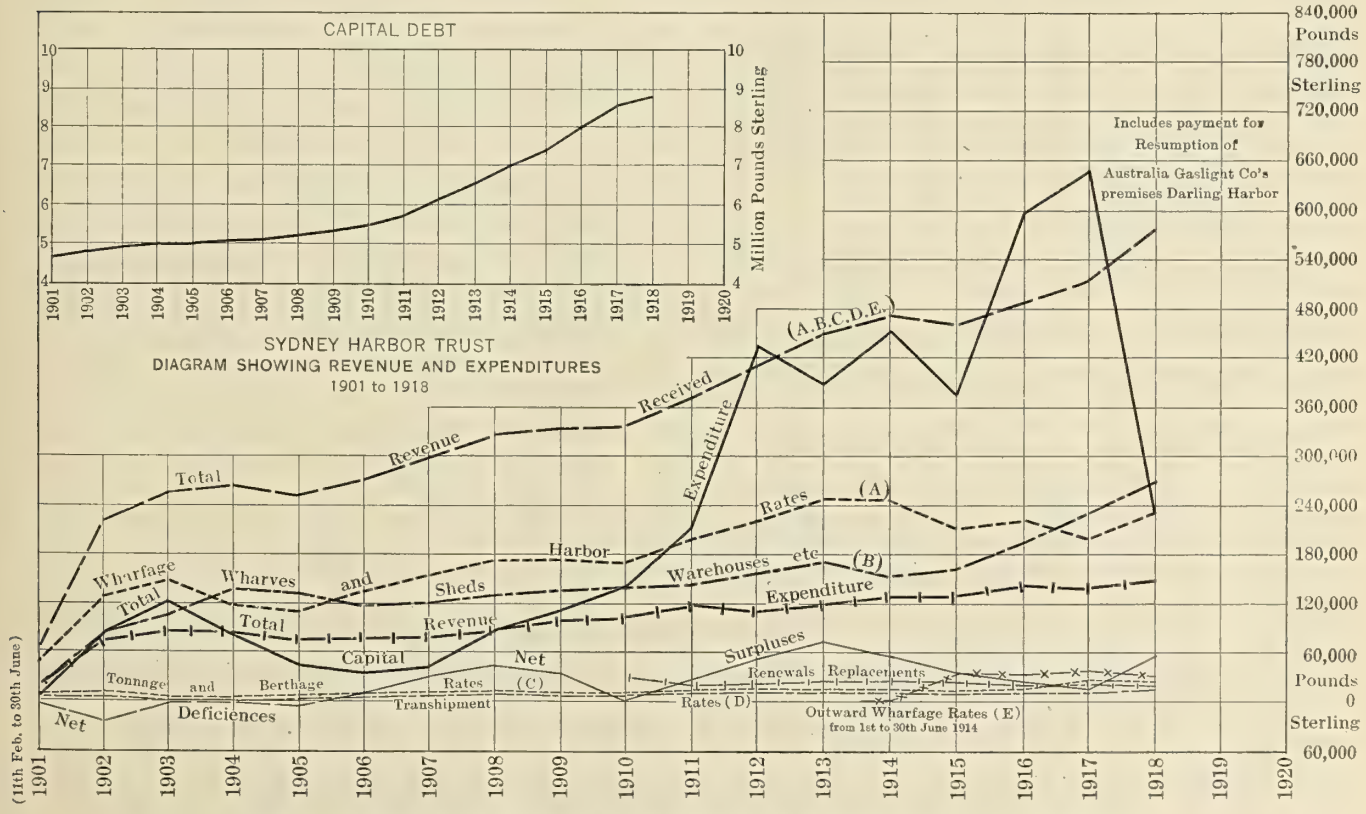


Fig. 2.—Diagram Showing Revenue and Expenditures of Sydney Harbor Trust 1901 to 1918

revenues and expenditures, but they would occupy too much space in this article.

The net tonnage of vessels entered at the Port is indicated on Fig. 1. This tonnage reached its highest peak in 1914, and then on account of the war continued to decline until June, 1918. It will be interesting to observe in the next report how quickly after the war the tonnage commenced to increase, and in what period it reached its high level of 1914.

This tonnage curve is made up of oversea and interstate tonnage (steam), state tonnage and oversea interstate and state tonnage brought in sailing ships, these separate revenues designated respectively (A, B, C, D). The maximum tonnage reached in 1914 was 9,400,000 net tons, and it had decreased due to the war to about 5,400,000 tons in June, 1918. In state or coastwise tonnage in steam or sailing vessels there was a much less proportionate decrease.

An inspection of Fig. 2 will show that the total revenue received, with one slight decrease in 1905 and another in 1915 due to the war, has been uniformly upwards, being $586,000 (£120,000) in 1901, up to $2,820,000 (£576,459) in the year ending June, 1918.

Increase of Income

This income, as per the chart, is made up of (A) wharfage and harbor rates; (B) wharves, sheds and warehouses; (C) tonnage and berthing rates; (D) transshipment rates; (E) outward wharfage rates. As the revenue is made up of five factors, one or more of these increasing will generally balance the deficiency of any other. For example, on account of the difficulty of shipping wool and copra, due to the scarcity of ships during the war period, the storage warehouse and sheds were filled and the revenue from this storage (B) was increased during the year ending June, 1918.

The expenditures were restricted most rapidly, as shown by the expenditure line on the chart, only such expenditures being made as were for the completion of work commenced before the war.

The above ratio of 26.19 percent of working expenses to gross receipts, while excellent, does not represent the ultimate possibilities as the net income of a terminal, as this terminal is not yet fully equipped. It is, however, a most excellent showing and reflects much credit upon the port management.

Requirements to Secure Best Results

The following are the requirements to secure the best results:

There should be a correct, comprehensive plan or design embodying the whole port, which may serve as the basis for all future improvements and an initial design plan more in detail for immediate development.

If the plan is not correctly designed, or is incomplete, or such that there are one or more points of congestion, causing delay or rehandling, then the initial investment and the cost of transference or handling is greatly increased, with a corresponding decrease in income.

If, however, all the elements of the whole terminal are correctly proportioned to each other, so that there is sufficient shed capacity for the berthing frontage with water and rail co-ordination and sufficient machinery for transferring between vessels and shore, and necessary mechanisms for handling, assorting, distributing and tiering on the shore, then wonderful results are attained in the speed of discharging and loading the ships and in all the other terminal movements. For example, by the use of electric traveling gantry jib cranes of proper size, with congestion eliminated by internal traveling cranes, the capacity per linear foot of frontage can be increased on the average from 150 tons per foot per year to 450 tons or even more per year.

This means that for an investment for a specified linear berthing frontage, three times as many tons can be transferred over this unit berth, thereby saving the investment in two more frontage berths, two more sheds and other terminal elements as railway tracks, drayways and paving. There is also the advantage of concentrating the terminal activities within the smallest area. Waterfront areas are of the greatest value, and therefore should be worked as intensively as possible.

In addition to the above, as three times the tonnage can be handled on the shore by machinery within the same time and with the greatest saving in manual labor, machinery doing this work, the operating cost will be less than one-third of what it was, even before the war, and one-fourth at least of present prices.

Still further, on account of this greatly increased speed in discharging and loading the ships, there will be a large saving in the time the ship is detained at the port, probably less than one-fourth the usual time now considered necessary.

Conclusions

From the above it may be deduced:

First: To secure the greatest income on the terminal investment, the terminal should be planned on the unit principle, both for installation and operation, each unit containing all the elements of a successful terminal and capable of earning a net income.

Second: The ratio of working expenses to the gross receipts should be kept at the minimum by a correct proportioning of the terminal elements to each other, and by the adoption and adaptation of the best mechanical facilities to secure the utmost speed in discharging and loading the ships, eliminating by machinery all possible congestion points, and having complete water and rail co-ordination.

Third: The greatest possible tonnage transferring capacity per linear foot should be obtained through the mechanical appliances, external and internal, as a larger tonnage means a larger income.

Fourth: The less detention of the ships, the more ships will use the terminal, resulting in more business and more revenue.

Fifth: All terminal works should be of a permanent nature, fireproof and decay-resisting, so as to reduce the maintenance expenses to a minimum, and to avoid delays to commerce through stopping of cargo transference for repairs.

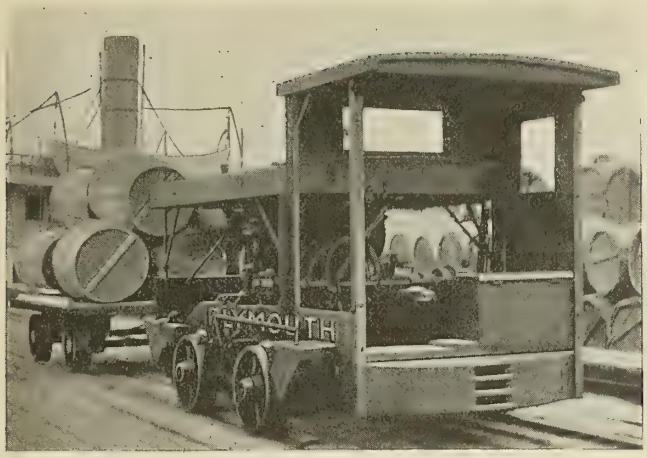
Sixth: If recognized correct terminal principles are ignored in plan or design, there will probably be a deficit instead of a net income.

Short Cuts in Cargo-Handling

BY PAUL TEAS

EVERY American has long known—vaguely, at least—that the dock and terminal facilities of European ports have been superior to ours. Now, however, if America's great new merchant marine is to even begin to live up to its opportunities it must be supported by the best of loading and unloading facilities. From the hour a vessel ties up at the pier, the one main consideration naturally is, how soon can she leave again under cargo?—this assuming, of course, that the vessel itself is not to be given any extensive repairs or overhauling.

The problem immediately becomes one of facility in removing and delivering cargo. A well-organized industrial railway system is, first of all, a good investment; but it is



Gasoline (Petrol) Locomotive in Service at Steamship Terminal

really much more. It is a plain essential, so far as the speedy, systematic handling of material goes.

A good type of industrial locomotive with suitable cars can handle an amazing tonnage. The length of the trip is not strictly a determining factor, though, of course, the farther the goods have to be hauled the greater the economy of mechanical transportation.

Compare the service of such a unit with either hand labor or animal power. Even when the cargo consists of packages that can be moved on trucks by hand, this method is slow and costly. The labor supply fluctuates, making the whole job risky and uncertain.

Much the same condition applies where horses or mules are used. The high purchase cost of the animals themselves, and the prevailing cost of feed and general upkeep expense, put a burden on animal haulage that makes it excessive and unreasonable.

The gasoline (petrol) locomotive, on the other hand, stands ready to shoulder the load and offers these proved recommendations in its own behalf:

First cost much less than that of enough animals to do the same volume of work.

Maintenance and upkeep cost far less than for feed and attention for animals—practically nothing more than the price of a few gallons of gasoline (petrol), a little lubricating oil and grease, and the day's wage of an unskilled operator.

Ability to do a maximum day's work, *every* day; the locomotive is a stranger to "days off" and "days after."

Extremely low overhead, reducing maintenance cost to practically nothing when locomotive is not working.

This latter item is applicable in installations where the unit operates only a part of the time, or where there may be long "gaps" of idleness. Many gasoline (petrol) locomotive owners have found them a sound investment even when hauling only a few hours a day, as compared with the cost of employing a force of men or buying and feeding enough animals to do the same service.

The accompanying illustration shows a "Plymouth" gasoline (petrol) locomotive owned by the American Can Company in service on steamship docks. It handles flat trucks of a type suitable for carrying barrels and similar packages, and operates on tracks running the length of the dock.

Units of this sort can be run on standard railroad tracks, or the same locomotives can, by a simple adjustment of wheels, be adapted to narrower tracks of any gage. They negotiate sharp curves readily and can be operated in closed buildings for hours together without causing this trouble from exhaust fumes.

Locomotives of the friction-disk method of transmission—the American Can Company's installation is of this type—provide a good range of speeds, both in forward or reverse. The operator has entire control of locomotive and load and is enabled to "pick up" quickly and to make prompt, accurate stops.

The loading and unloading facilities of a port exert a mighty influence on its future. With an immense production of manufactured goods at home, a market overseas ready to absorb them, and a splendid fleet of ships ready-built to carry them, America's opportunity is certainly at hand to step into permanent place among the world's maritime powers.

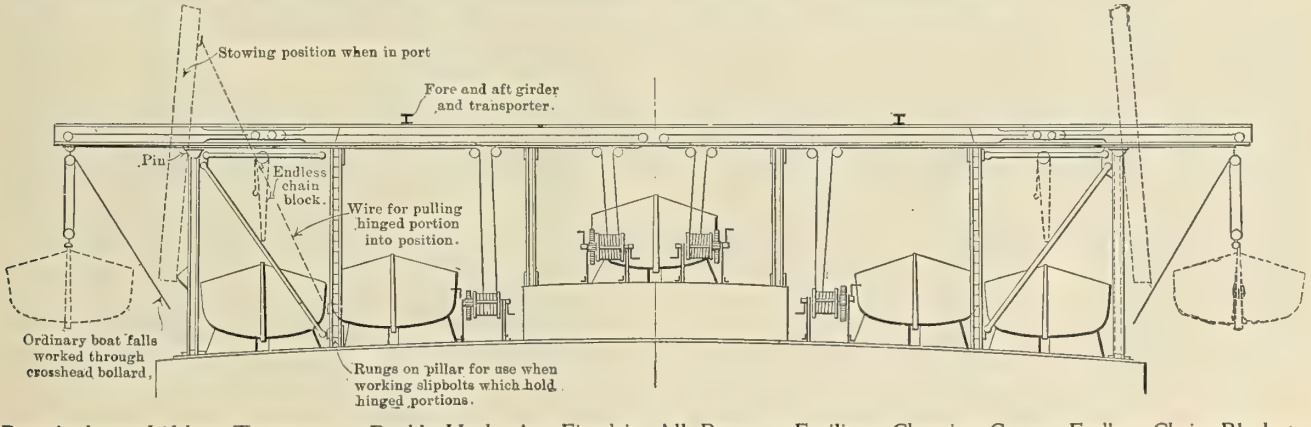
But that place will be hotly contested. It will become a question, among other things, of ability to transport cheaply, to handle goods efficiently, which simply means handling them without wasted time or motion.

Small particulars may become vital factors; incidental savings will help throw the balance. Better facilities at docks and terminals for loading, unloading and rehandling will make it easier for American shipping to hold to the trade that belongs rightfully to you and me—to every one of us.

Don't overlook the details!

The Ross-Anderson Lifeboat Transporting and Lowering Gear

The accompanying illustration shows a new lifeboat transporter which has been devised by Alexander Ross and John Anderson, of Scotts' Shipbuilding & Engineering Company, Ltd., Greenock, Scotland. By this arrangement the transporting gear, which is directly overhead, provides direct traverse from the extreme port to the extreme starboard side of the ship, as well as fore and aft traverse, making it possible to launch a boat stowed within the compass of the overhead gear from any position either on the port or starboard side.



Ross-Anderson Lifeboat Transporter. Double Hooks Are Fitted in All Boats to Facilitate Changing Groove Endless Chain Block to Boat Block



Fig. 1.—S. S. *City of Eureka*, Built by Columbia River Ship Building Corporation in 37 Working Days

Pacific Coast Yard Builds 8,800-Ton Freighter in Thirty-Seven Days

THE Columbia River Ship Building Corporation, Portland, Ore., established recently a record in ship construction by completing the 8,800-ton freighter *City of Eureka* in thirty-seven, sixteen-hour working days. The keel of the vessel was laid April 4, 1919, and on May 22 the completed ship was given her trial run.

Photographs taken during the progress of the work show the remarkable speed with which the ship was assembled and fitted. On April 4, the keel was laid; by April 8, all floors were in place; on April 14, the frames were erected; on April 23, the second deck plating had been riveted into place, and the pillars and girders were in position for the main deck; on April 25, the superstructure had been riveted and finished. On May 8 the ship was launched after exactly twenty-seven working days, which is probably the shortest time taken by any

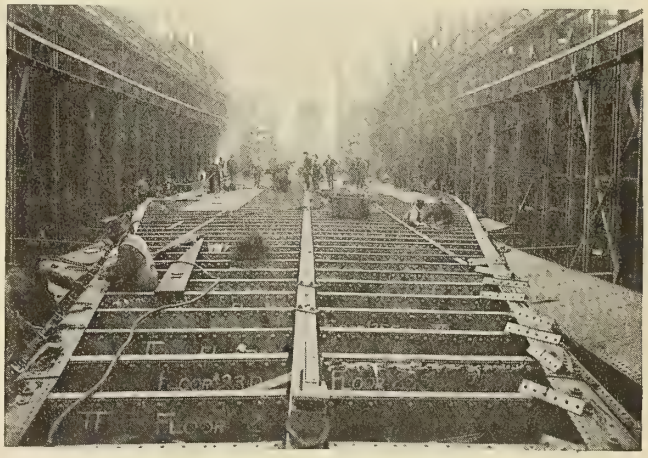


Fig. 3.—Floors in Place by April 8

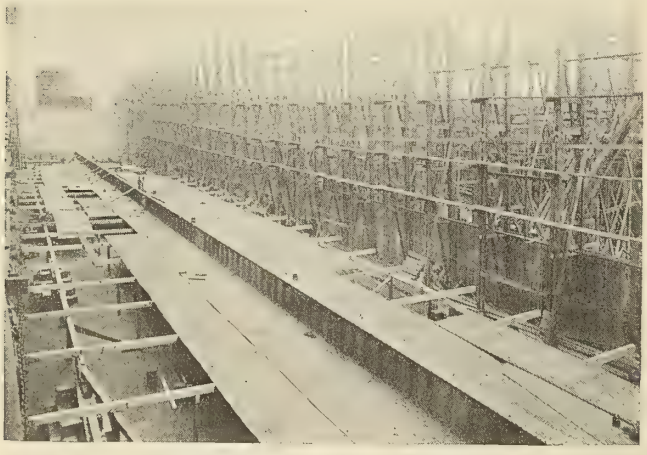


Fig. 2.—Keel Laid on April 4



Fig. 4.—Frames Erected on April 14

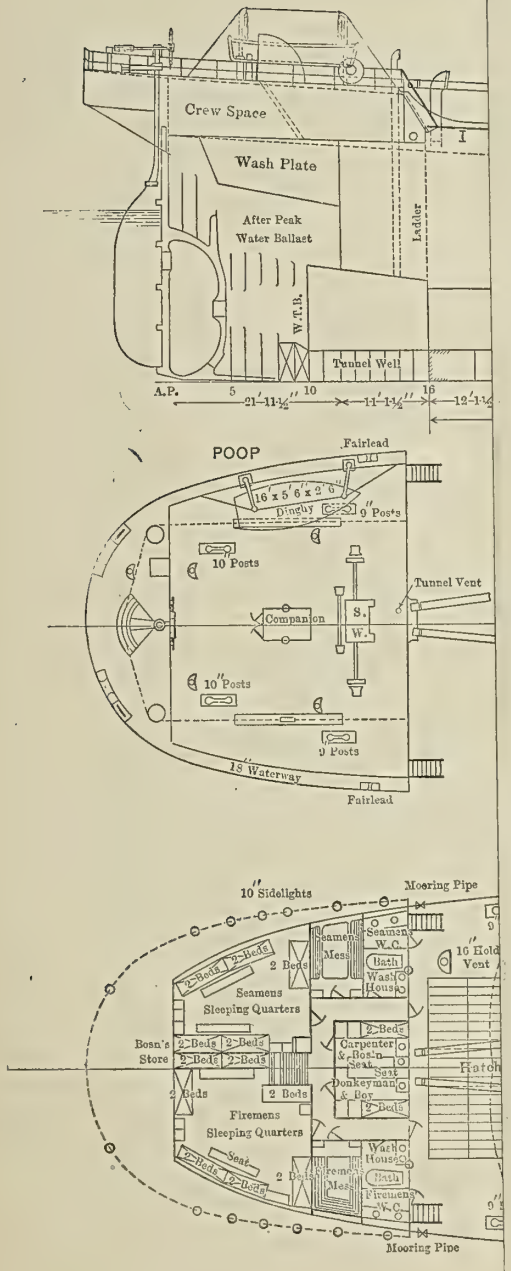

Crew Space
Wash Plate
After Peak
Water Ballast
W.T.B.
Ladder
Tunnel Well
A.P.
5
21'-11½"
10
11'-1½"
16
12'-1½"
POOP
Fairlead
16 x 5' 6" x 2' 3"
Dinghy
9" Posts
10" Posts
Companion
S.
W.
Tunnel Vent
18" Waterway
10" Sidelights
Mooring Pipe
Seamens Mess
Seamens W.C.
Bath
Wash House
16" Hold Vent
2 Beds
Seamens Sleeping Quarters
Bosn's Store
Carpenter & Bosn
Seat
Donkeyman & Boy
Hatch
Firemens Sleeping Quarters
Firemens Mess
Firemens W.C.

Fig. 3.—Con

SHIPBUILDING IN AUSTRALIA

Commonwealth Standard Ship, Building at Newcastle Government Dockyard

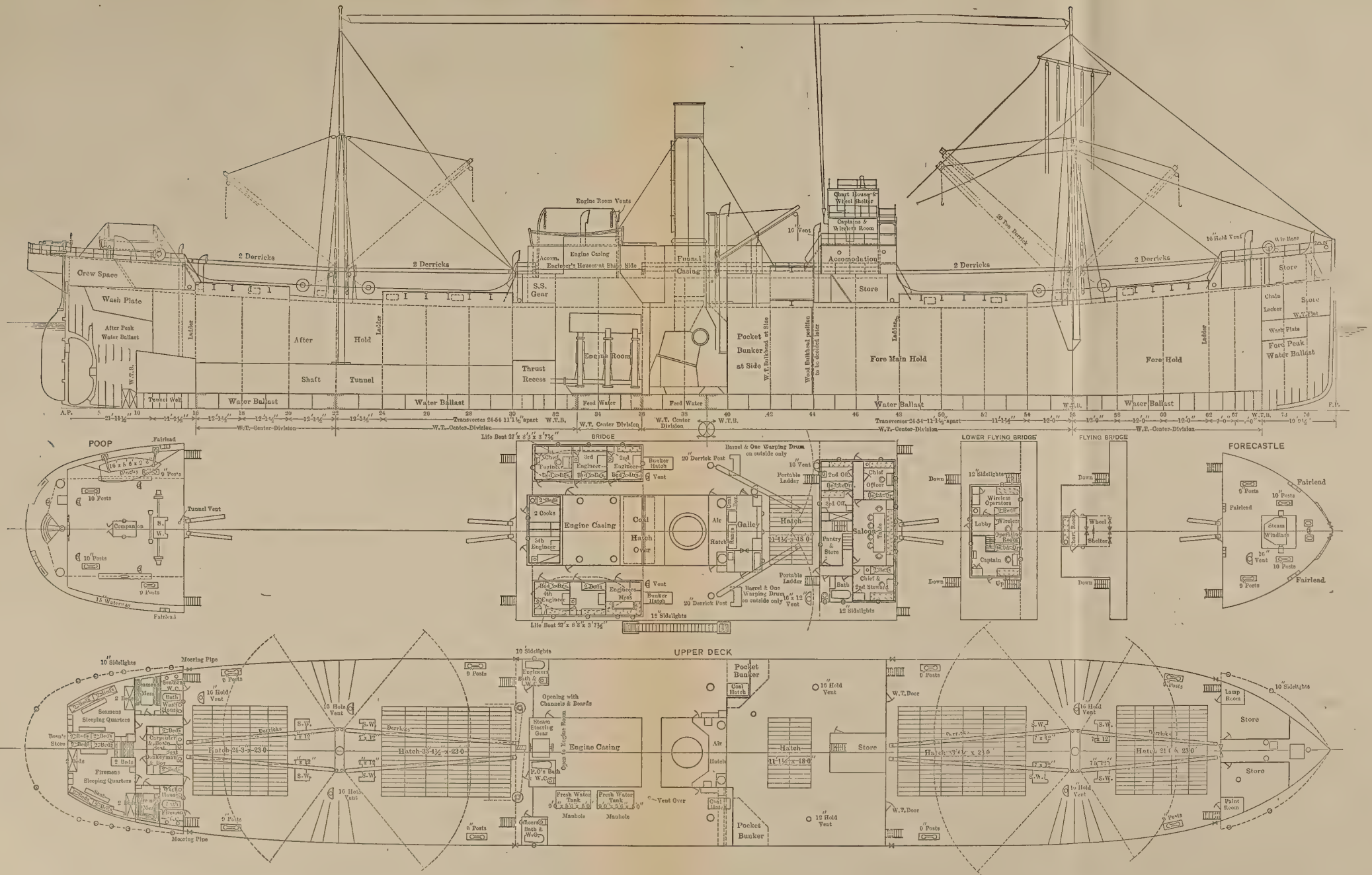
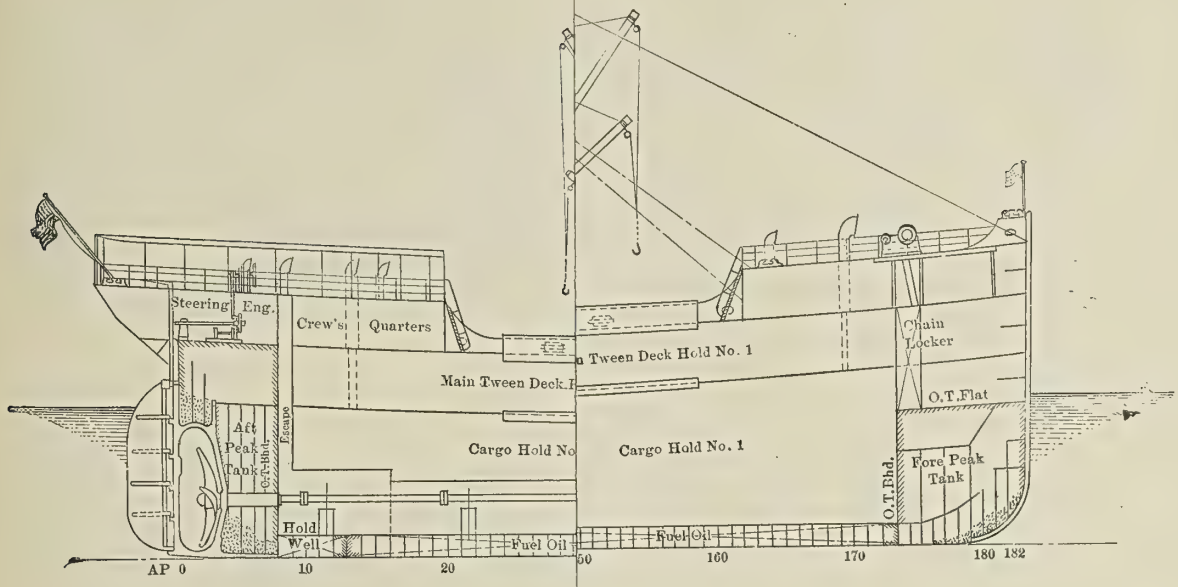
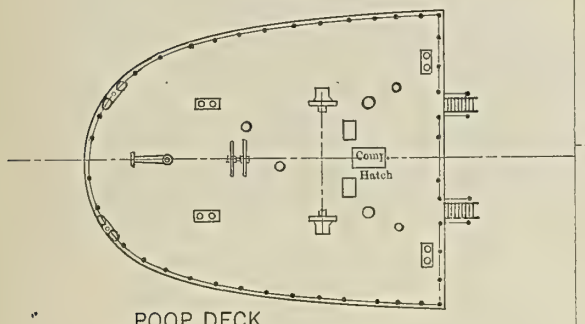
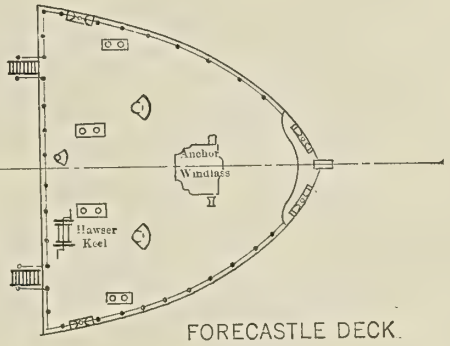


Fig. 3.—Commonwealth Standard 5,500-Ton Ship. Length Between Perpendiculars, 331 Feet; Beam, Molded, 47 Feet 9 Inches; Depth, Molded, 26 Feet 1 Inch; Indicated Horsepower, 2,300; Speed, 10 Knots

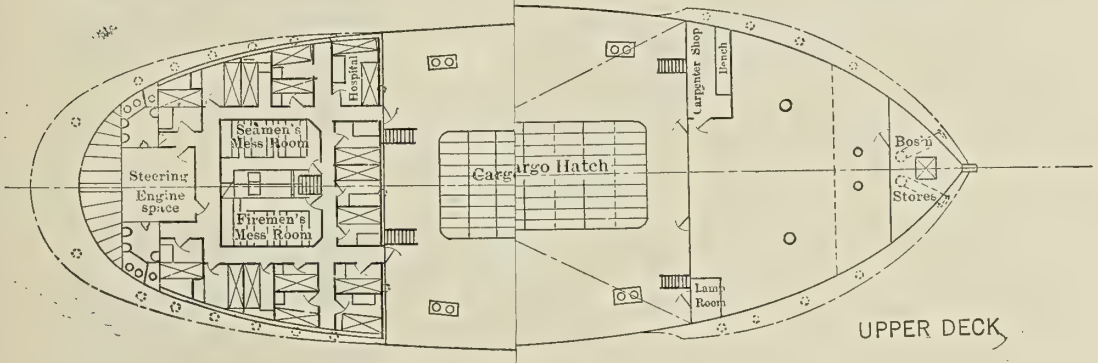




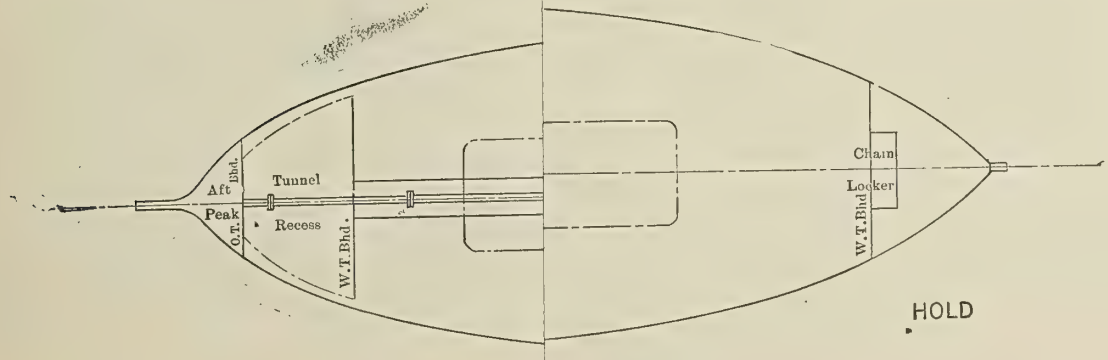
POOP DECK



FORECASTLE DECK



UPPER DECK



HOLD

8,800-Ton Steel Freighter Built in Thirty-Seven Days

Shipbuilding Record Established by Columbia River Ship Building Corporation, Portland, Ore.

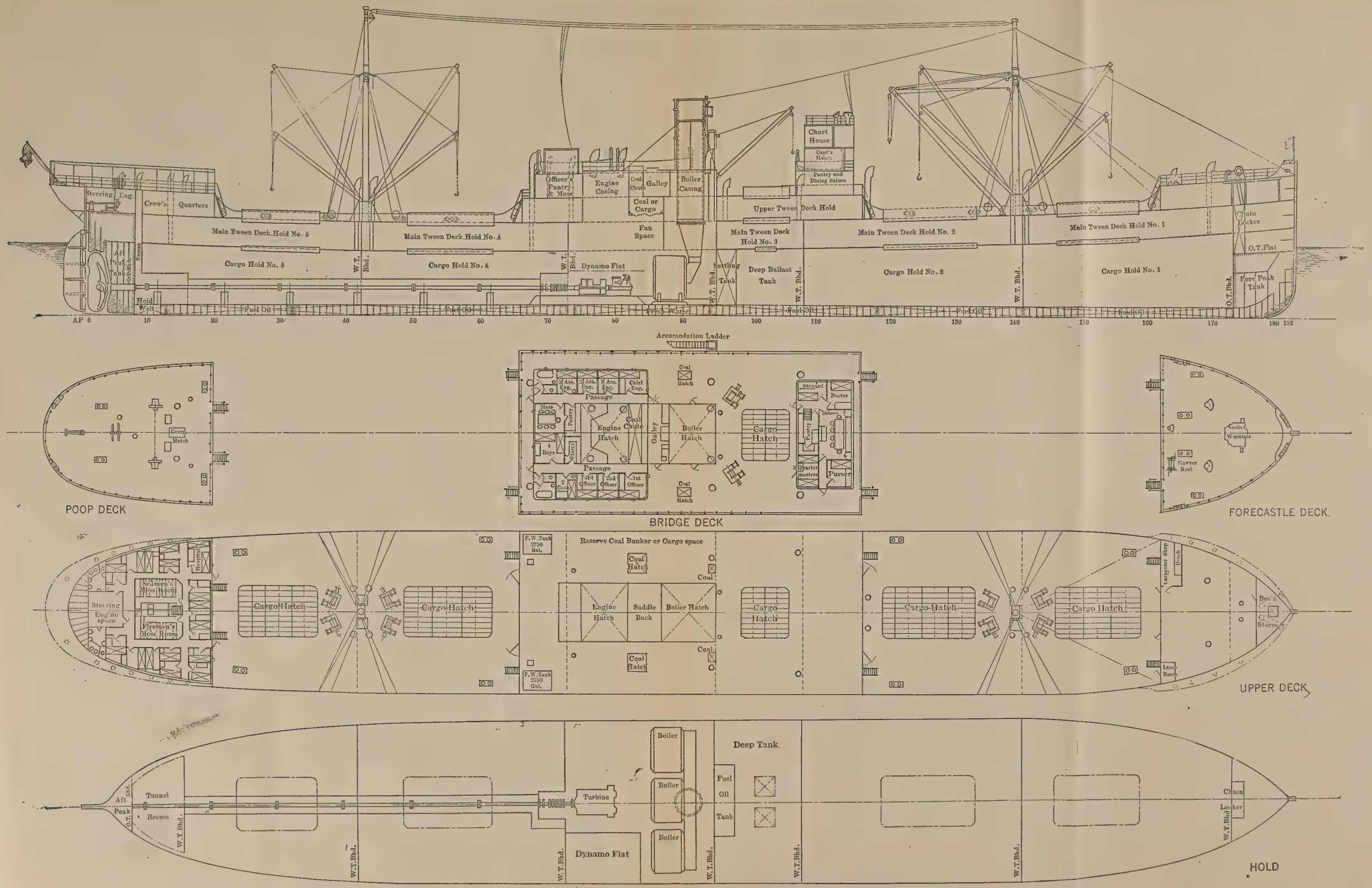


Fig. 5.—General Arrangement Plans of 8,800-Ton Steel Freighter *City of Eureka*

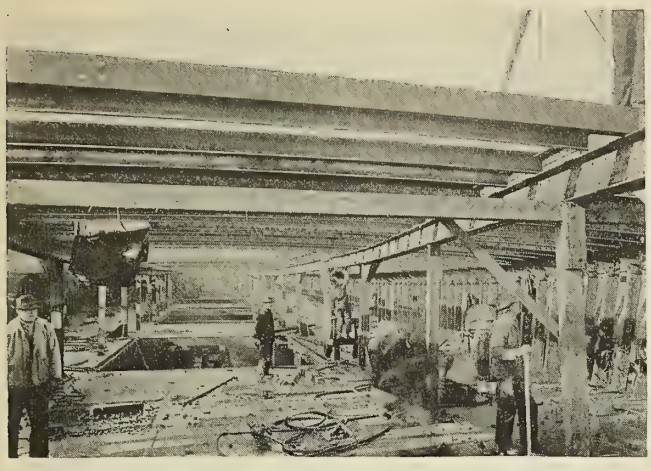


Fig. 6.—Main Deck Girders in Place on April 23

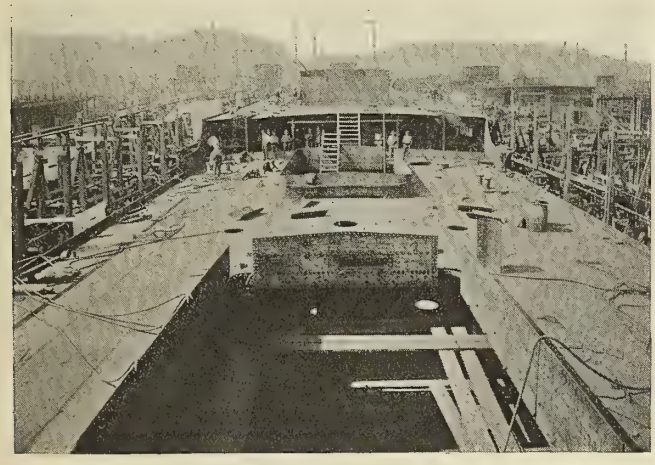


Fig. 7.—Superstructure Finished on April 25

American concern for similar construction. Between this date and May 16 the boilers and engines were completed, all deck work, stacks and rigging erected, so that by May 22 the ship was towed down river for her trials.



Fig. 8.—Vessel Launched on May 8, Twenty-seven Days After the Keel was Laid

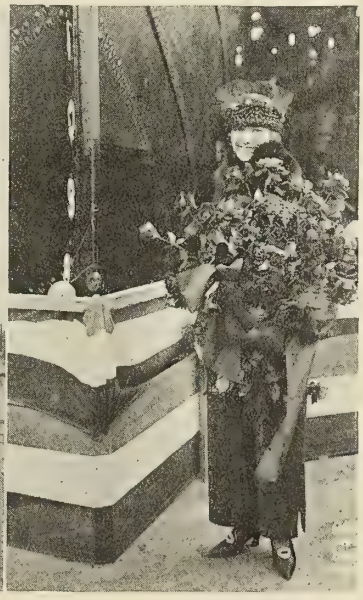


Fig. 9.—Mrs. Alfred F. Smith, Sponsor of the Vessel



Fig. 10.—Machinery on Board and Rigging Finished on May 16

The vessel is of the 8,800 deadweight-ton type, having a length of 410 feet 5½ inches between perpendiculars, a molded beam of 54 feet, a molded depth at the lowest point of sheer of 29 feet 10 inches, and a draft of 24 feet 2 inches. She is equipped to burn oil, and is driven by a 2,500-horsepower General Electric turbine, geared to a 17-foot, four-bladed, bronze propeller. Three marine Scotch boilers, manufactured by the same corporation, are installed. All joiner work, stock construction and breeching in connection with the vessel, were produced as well.

Shipbuilding at Malmo, Sweden

Nine vessels, including warships, were launched at Stockums Wharf at Malmo during 1918. The yard has under construction two vessels of standard type, one for Göta, of Goteborg, and one for Gorm, of Copenhagen. The steamer *Freja*, of 2,300 tons deadweight, which was launched at Linhamns Wharf, has been delivered to the owners, Travers Steamship Company, of Goteborg. Two steamers of 4,000 tons are under construction at Oresunds Wharf for Svenska Handels & Sjöfarts Company for transatlantic trade. Three steamers of 1,850 tons are also under construction. The second of these boats was launched in March. The Hallandia Steamship Company, of Halmstad, has bought from Viking Steamship Company, of Goteborg, four steamers—*Dettern*, of 1,600 tons; *Ruskin*, of 1,250 tons; *Barken*, of 1,500 tons, and *Neptunus*, of 1,700 tons.

The Malmo merchant fleet decreased during 1918 by 13 vessels of 21,519 tons. These vessels were sold to Denmark, Norway and north Swedish ports. Shipping interests in Helsingborg are negotiating for the purchase of 20 additional vessels.

Electric Wiring on Board Ship.—For an 8,000-ton freight ship about 9,500 feet of electric wiring will be used in sizes varying from No. 16 B. and S. gage to No. 0. The No. 16 B. and S. gage is used for interior communication.

A Cost System for Shipyards

Uniform Methods of Cost Accounting Advocated—Costs Defined—Structural Classification—Labor and Material Charges

BY CREIGHTON CHURCHILL*

THE necessity for a thorough and simple method of cost finding in the shipbuilding industry is generally recognized. This need is in evidence more particularly in the newer yards, which have hardly been in existence a sufficient length of time to derive the natural benefits of a perfected organization. The greatest danger from the lack of an accurate knowledge of costs is the demoralizing effect produced on the industry as a whole when it is building ships on a competitive basis. The yard which is in possession of an actual knowledge of costs is liable to be underbid by a competitor which is not in possession of such knowledge to the detriment of both—one loses the business and the other loses money. In the latter case, where the low bid may be below cost on account of the lack of adequate cost finding methods, the purchasers of these low-priced ships may benefit for a time, but eventually the losses will be greater than the funds which are available to pay them, and the yard will cease to do business when that time arrives.

In similar lines of industry, as a matter of self-protection, the tendency of the times is toward uniform methods of cost finding. Where associations of manufacturers have recognized this fact and have been successful in arriving at a satisfactory solution of the problem, the benefits have been very marked, and in many cases have pointed the way to faults in management and methods which otherwise might have failed to come to the surface. The very least that can be said of a uniform cost method in any particular industry is that it prevents ruinous competition due to ignorance, and eventually will bring about the survival of the fittest, or, what amounts to the same thing, make the unfit see the error of their ways.

An indirect but very important result of a comprehensive knowledge of costs, derived from a logical system applicable to a particular industry, is the possibility of measuring the efficiency both of the work of individual men and departments and of the yard as a whole, provided that the data accumulated are properly used. In the final analysis, costs determine the success or failure of a business. If accurate costs are presented to executives in a timely and tell-tale way, many a fault can be corrected at its start rather than after the damage is done. In other words, an up-to-date system should provide immediate and adequate records which are not mere history, written up a long time after the event has transpired. At the present time it is common practice for many concerns to sell their product at prevailing market prices because they never know exactly what that product costs for weeks and sometimes months after the books have been closed for the year. Their costs are averaged against output and inventory is taken once a year, all of which tends to uncertainty. This method of cost finding is now generally looked upon as inefficient and even hazardous under certain conditions. An up-to-date cost system usually goes beyond the mere function of determining costs by providing the means of accounting for work in process, which, coupled with a perpetual inventory, permits a statement of the business to be made monthly or quarterly, as may be desired.

* Member of firm of Churchill & MacLeod, New York.

Another feature of a well-designed cost system that appeals to the progressive executive is the information which is available when a plant is operating below its normal capacity. It then becomes necessary to reduce the margin of profit in order to attract more business rather than have the business already acquired absorb the expense of idle equipment. Nothing eats into the profits of an industry more than idle equipment, hence the cost of such idle equipment should be an open book and used to the fullest extent. This feature will be more fully discussed under "Overhead."

Aside from the current information furnished by a cost system, it should also provide the necessary data for cost analyses covering the various classes of output or the various parts of an assembled product. Such analyses are often productive of radical changes in policy. They may show where certain parts can be bought outside more cheaply then they can be made, or, on the contrary, it may be evident that it would be a good investment to equip the plant for manufacturing certain parts rather than to purchase them outside.

Cost accounting is or should be distinguished from general accounting. In too many cases cost methods have been developed from a purely accounting point of view, partly or totally ignoring the operating or engineering element involved—a case of the tail wagging the dog, so to speak. As a matter of fact and common sense, a cost system should be built up to suit a particular industry and then tied in with the general accounts to complete the financial records. Inasmuch as every industry is carried on through some sort of an organization which provides for dividing up the activities in accordance with the make-up of the output, and, as these activities are the source of all charges against such output, it would appear logical to use the organization as the basis for a cost system. Such procedure will enable any yard to apply to its particular organization the system herein developed by making the necessary changes in detail. Furthermore, the application can be made without any confusion when the preliminaries are completed. If generally adopted, the solution of uniform costs in the shipbuilding industry would be the very simple matter of accumulating cost data according to the accepted rules and regulations.

Uniformity in Methods

To obtain the full advantage of uniform cost methods in any industry it is of the greatest importance to agree upon uniform terminology and to decide what disposition is to be made of the various items of labor, material and overhead which make up the final costs. Little or no difficulty presents itself in disposing of direct labor and direct material costs. Such, however, is not the case with overhead, an item which may be treated in a variety of ways. In the shipbuilding industry it is customary to consider overhead as a certain percentage of direct labor. This is open to objections for several reasons, but primarily because such a custom, while undoubtedly including all items in the final cost, does not tell the true story of the day-to-day operation of a plant, nor does it indicate specifically the particular accounts among which the overhead should

be apportioned and whether or not this distribution, if made, is excessive in regard to any one account. In other words, it is treated simply from the accounting rather than the operating point of view. It would appear, therefore, that before much headway can be made on a uniform cost system it will be necessary to give a comprehensive definition of costs to be supplemented by a structural classification such that all types of ships can and will be included.

Overhead is always a bone of contention and will not be discussed at length. Suffice it to say that the distribution of overhead as a percentage of direct labor, the usual method employed by shipyards, is open to serious criticism. In order to get a better and more correct distribution, it is a much better practice to locate overhead at its source as far as possible, with special reference to indirect labor and depreciation. In this connection it might be well to mention that idle equipment due to lack of business should be a profit and loss charge and not an overhead charge, otherwise many a contract will be lost in competition with a yard that is fortunate enough to have a normal capacity business on its books. This is plain common sense, if viewed from the proper angle, for it may well mean the difference between a small profit and an actual loss. In fact, cases are of record where a certain loss was turned into a profit by taking a new contract at actual cost, all of which was due to no other cause than the absorption by the new contract of the overhead through use of what otherwise would have been idle equipment.

Locating overhead at its source offers no difficulties from a cost accounting point of view. It simply means that the various plant structures and their equipment should be appraised at their proper value and charges for depreciation and maintenance made accordingly. The indirect labor cost is simply a matter of making a charge to a standing order which automatically goes into overhead through control accounts. Not the least advantage of such a method is the opportunity it gives executives to locate and give their attention to the high points in operating expenses.

In addition to the costs by structural classification, shipbuilders usually want to know the costs by crafts, such as riveting, shipfitting, etc. This can be taken care of by a simple system of using workmen's numbers in combination with shop symbols for the designation of individual charges, so that the desired costs may be allocated by sorting out the charge numbers covering the cost in question. In this connection tabulating machines will pay for their use many times over, and, in addition, will afford opportunities for cost and production analysis that otherwise might appear almost hopeless to obtain.

In the process of arriving at final cost, unit costs can be established for all of the work and output of a yard. This brings up the question of determining proper units in order to utilize cost information for estimating. It is not believed necessary to outline a system of units, though it is suggested that certain standard units be fixed and that suitable factors be developed to make these units applicable to changed conditions. For example, should the unit cost of erecting a ton of steel be taken, it will vary inversely as the weight of the steel per square foot which is the basis for specifying shell plating. This, of course, is on the assumption that the labor cost for erecting a 4-foot by 12-foot 20-pound plate is practically the same as for a 4-foot by 12-foot 30-pound plate.

Definition of Costs

1. *Direct Labor*
   All direct labor employed in construction of vessels, including quartermen, leading men and gang foremen, who are directly chargeable to such construction, but not including labor of an indirect or supervisory nature.
2. *Material*
   All direct materials, machinery and equipment incorporated in the vessels or required to be furnished at net cost, f.o.b. yard.
3. *Overhead*
   All indirect labor and material necessary to operation and maintenance of plant, including power, heat and light and supervisory labor.
   Executive and department head salaries.
   Clerical and drafting room salaries, except where the latter can be charged directly to a specific job or contract.
   Plant, builders' risk and liability insurance premiums.
   Taxes, ex-corporation and federal.
   Depreciation.
   Rent of equipment.
   Registration, inspection fees, etc.
   Cost of molds, templates and designs when not chargeable to specific job or contract.
   Reasonable allowance for spoiled work.
   Office expenses, including supplies, telegraph and telephone service.
   Transportation for employees.
   Welfare work, including restaurant losses within reason.
   Travel expense.

The following are not to be included in overhead, but are to be directly chargeable to profit and loss, the proper reserve account or to capital investment:

Advertising and selling expense other than executive and department head salaries.

Collection expense or bad accounts.

Legal expense other than executive and department head salaries.

Research expense.

Expenses, bonuses or commissions for sale of stock or bonds.

Interest charges on bonds or other indebtedness.

Entertainment expense.

Donations or bonuses in addition to salaries.

Replacements or extraordinary repairs.

Structural Classification

Ship costs vary considerably, depending on the type of ship being built; yet all types of ships are subject to a very close and specific structural classification for cost purposes. Another purpose for which costs must be obtained is the preparation of estimates to be used in obtaining new business on a competitive basis. If, therefore, the actual costs and estimates can be combined so that the structural classifications for the former can be utilized for the latter, not only will time be saved but the cost records accumulated will be in such shape that they can be used directly for estimating. As these records have been prepared by the cost accounting department, which is the department most versed in the knowledge of all ship costs, it naturally follows that this department is the logical place for the preparation of estimates rather than the engineering department, although the data on which the estimates are based must of necessity be prepared by this latter department. To get back to the main idea, however, the following structural classification for costs and estimates applies to any type of vessel, but must be

supplemented by general specifications covering dimensions, cargo capacity, passenger accommodations, classification, etc.

The three general headings for classification are hull, operating equipment and machinery, each of which is subdivided into its component parts, and these in turn further subdivided into the units which make up the part.

1. *Hull*
   - (a) Main steel structure.—Scantlings, keel, stern frame, bulkheads, shell plating, engine and boiler foundations, etc.
   - (b) Secondary steel structure.—Engine and boiler casings, deck houses, tanks and swash plates, foundations for auxiliary machinery, cargo hatches, masts and booms, etc.
   - (c) Hull fittings.—Hawse and chain pipes, boat and anchor davits, ventilators, manholes and scuttles, bitts, chocks, etc.
   - (d) Carpenter work.—Calked decks, hatch covers, cargo battens, ceiling, boat chocks, etc.
   - (e) Joiner work.—Beam capping, side ceiling, bulkheads and partitions, doors, stairs and ladders, grab rails, interior finish, fixed furniture, gratings, etc.
   - (f) Cementing, painting and deck covering.—Cementing, bituminous coatings, hull painting, tiling, linoleum and floor composition, etc.
2. *Operating Equipment*
   - (a) Hull equipment.—Standing rigging, cargo gear, anchors, chains, cables, hawser, running rigging, boat falls, boats, rafts, fire buckets and axes, fire extinguishers, running lights, nautical outfit, etc.
   - (b) Furniture and furnishings.—Desks, chairs, lockers, berth, springs, safes, etc.
   - (c) Outfits.—Deck, carpenters, lamps and lamp room, paint and oil room, galley and pantry, mess outfits, carpets and rugs, mattresses and pillows, blankets and linen, etc.
3. *Machinery*
   - (a) Hull machinery and hull engineering.—Windlass, capstans, cargo hoisting engines, steering engine, fire main and deck wash systems, bilge and ballast piping, cargo oil piping, sanitary system, plumbing fixtures, electric plant, heating, refrigerating plant, ventilation, exterior and interior communication, pipe covering, etc.
   - (b) Propelling machinery.—Main engines or turbines and reduction gears, main condenser, line and thrust shafts and bearings, stern tube, lubrication, propellers, gages, instruments, clocks, lifting gear, attached pumps, independent pumps, evaporator and distiller, auxiliary condenser, feed water heater, main boilers, donkey boiler, piping, machine tools, engine and fireroom outfit and tools, consumable stores, etc.

By using such a classification and carrying the subdivisions to the extent demanded by good practice, costs can be assembled to any degree of refinement. Each subdivision is made up of material, labor and overhead if it is produced at the yard. Items which are purchased outside should be charged into general or contract stores when they are received and then should be charged out against a specific hull when they are issued from the stores. This applies to hull steel just as well as to any other direct material, on the theory that until it is issued no material is charged to a vessel under construction, although it was specifically purchased for that vessel. If material were not charged in this way, it would be almost impossible to get an accurate account of work in process without an actual physical inventory.

Labor and Material Charges

Charges for direct and indirect labor, other than salaried employees paid on a weekly or monthly basis, are covered by time cards or work tickets, clock cards or a check system or combination of these. Irrespective of the method used, it is important that all direct and indirect labor be accounted for in hours, whether it be on a day work or piece work basis. The necessity of accounting for labor in hours arises from the fact that the man-hours required to complete a definite amount of work have a direct bearing on the estimated time of its completion, and this knowledge, other things being equal, is extremely valuable in the preparation of estimates which are to be used for competitive bidding.

It is recognized that the actual form of time cards, work tickets, material orders, repair orders and any other means of accumulating records of labor and material which have been expended on output or in the maintenance of the plant is not important as long as all the required information is recorded in such shape that it can be utilized for cost purposes as well as to furnish the necessary data for making up the payroll. No attempt will therefore be made to draw up such forms, but the information required thereon is listed as follows:

Time Cards of Work Tickets

1. Date.
2. Department or shop by symbol.
3. Man's number.
4. Hull number and job order number.
5. Hull section or berth number.
6. Description of work.
7. Hours worked, quantity of work, rate and amount.
8. Signature of timekeeper or supervisor.

Material Orders

1. Date.
2. Department, shop, hull number or job order number for which wanted.
3. Description of material and quantity wanted.
4. Amount issued, unit price and extension.
5. Stores classification receiving credit.
6. Department or shop of origin and signature of proper authority.

Repair Orders

1. Date.
2. Description of work.
3. Department or shop charged and standing order number.
4. Labor cost, material cost and total cost.
5. Department or shop of origin and signature of proper authority.

   NOTE.—If a replacement charge, so note on face of order.

Job Orders

1. Date.
2. Department or shop to which issued.
3. Hull number or job order number.
4. Description of work and amount wanted.
5. Drawing number, part number.
6. Material and amount required.
7. Date wanted.
8. Department or shop of origin and signature of proper authority.

(*To be continued.*)

The Cost of Manufacturing Ships

Method of Determining the Cost Per Deadweight Ton of Vessels Under Construction from Weekly Production Reports

BY FREDERICK THORNE WARNER*

ONE of the most important questions that confronts the shipbuilder of to-day is, probably, "What is the present cost to me of manufacturing ships?" It is not enough to know what No. 1 or No. 6 ship costs, as a great deal of their construction was done during a period of less efficiency—possibly overtime, etc. He must know his current cost.

This is an especially pertinent question in the newer yards where a greater difference in costs is being effected weekly—and the relative differences between the costs of each ship are so great, but obtained so late. A large proportion of these newer yards are building ships of the same type and at present have ships in all stages of construction. It is to yards in this class and under the conditions stated that this discussion is primarily intended to apply.

In a yard building ships of the same type and with ships in all stages of construction, it is possible by using weekly reports on production to consider that the work was all done on one ship, and by so doing to obtain the ships per year at the rate of the week in question. This easily resolves itself into deadweight tons per year, etc., which is probably quite common data in shipyards and has been useful in the past in showing the speed. In this discussion it is attempted to arrive at the cost of a deadweight ton at the rate of the week in question. The chart shown in Fig. 1

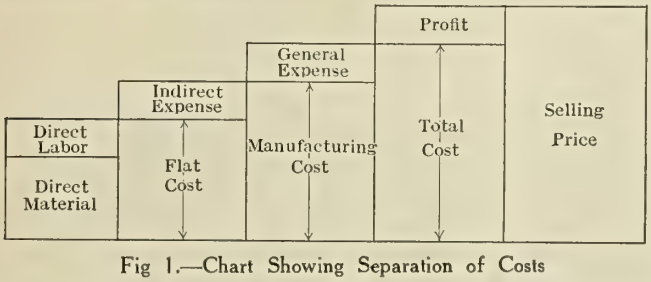


Fig 1.—Chart Showing Separation of Costs

will give an idea of the common practice in the separation of costs, to which we will refer later.

For the purposes of this discussion the question of profit will not be considered, and manufacturing and general expense will be grouped. Therefore we will take three items:

(1) Direct Material
(2) Direct Labor
(3) Overhead

First.—On the date of writing it is safe to assume that one ship has already been delivered and that the detailed bills of material have been priced to such an extent that even with additions and deductions the direct material cost of a ship is accurately known.

Second.—The direct labor we will obtain from our accounting department.

Third.—The overhead we will obtain from our accounting department.

Armed with these data we will proceed as follows: Production report for week ending May 10 shows:

Rivets driven	100,000
Tons erected	400
Tons fabricated	500

Basis of rivets driven (assuming 600,000 rivets in ship)

$$\frac{100{,}000}{600{,}000} = \frac{1}{6} \text{ ship, or } \frac{52}{6} = 8.66 \text{ ships per year.}$$

Basis of tons erected (assuming 2,600 tons to be erected in ship)

$$\frac{400}{2{,}600} = \frac{2}{13} \text{ ship, or } \frac{52 \times 2}{13} = 8 \text{ ships per year.}$$

Basis of tons fabricated (assuming 2,600 tons to be fabricated for ship)

$$\frac{500}{2{,}600} = \frac{5}{26} \text{ ship, or } \frac{52 \times 5}{26} = 10 \text{ ships per year.}$$

In an attempt to weigh these items with some degree of accuracy and by considering their relative costs and the work required before each of these operations can be performed we have given the following values:

Riveting	45 percent
Erecting	35 percent
Fabrication	20 percent

Therefore we have by

riveting	8.66 × .45	= 3.9
erecting	8 × .35	= 2.8
fabricating	10 × .20	= 2.0

and on all items considered, 8.7 ships per year.

In connection with the weight assumed, it should be noted that almost any approximation will compensate in a long run, but consideration regarding the weight is necessary for weekly comparisons.

In regard to the number of items of production considered, i.e., riveting, erecting and fabricating, it may be said that these will not be a fair guide in the production of ships when the installation of machinery, joiner work and piping are such important factors. It must be remembered that we have considered only "ships in all stages of construction." Therefore our assumptions are not unsafe, but if some scheme can be devised to secure definite unit measures of production (not labor hours consumed) in wood work and machinery installation, and such are quite possible to approximate with sufficient accuracy for the result, then our solution will be the better for it. As it is, we will be incorrect in our deductions only if outfitting, say, is stopped for the week in question or if some structural work is stopped, or very much unbalanced conditions exist. If the yard is quite small and the work is unbalanced, the monthly check on the same basis will be better. However, in a yard with six ways or over, producing six ships per year or over, the weekly basis will, in 90 percent of the weeks taken, be satisfactory.

Assume the direct material for one ship costs $500,000. At the week in question we would have used

$$\frac{\$500{,}000 \times 8.7}{52} = \$83{,}654 \text{ worth of material.}$$

Added to this and the direct labor payroll of $100,000 and overhead of $50,000, or $100,000 plus $50,000 plus $83,654 equals $233,654, which is the total cost of manu-

* Production engineer, Groton Iron Works, Groton, Conn.

facturing $\frac{8.7}{52}$ ships during the week in question.

Assuming 8,800 deadweight tons per ship, we have $\frac{8.7 \times 8{,}800}{52} = 1{,}472$ deadweight tons completed during the week for $233,654, or $\frac{233{,}543}{1{,}472} = \$158$ per deadweight ton.

With this figure weekly, or in a smaller yard monthly, the manager can see for what figure new contracts may

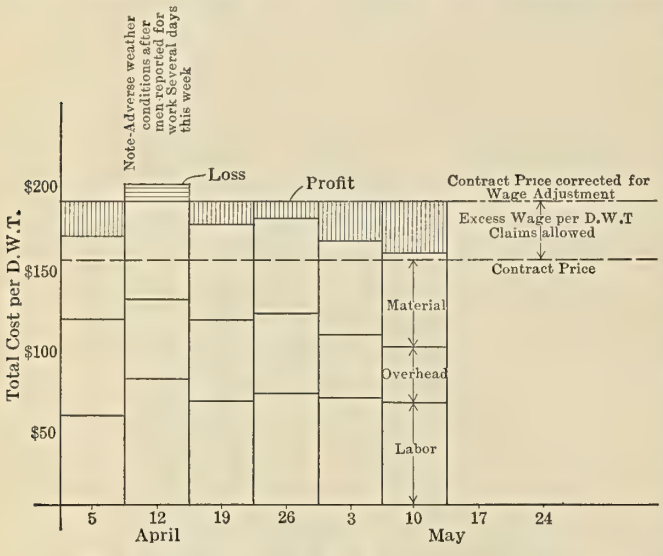


Fig. 2.—Chart Showing Profit or Loss on Contract

be taken and not wait until various ways are idle and the costs are obtained from accountants on ships as they are delivered; nor depend upon figures submitted by the more technical men who were before the war so much relied upon.

Were it practicable to break a ship down into sections and keep costs on the construction of each section, such a scheme as has been described would be unnecessary. This has been attempted many times, but without success, and the structural steel hull, representing about 70 percent of the cost, is thrown into one account, which opens with keel laying and closes with delivery. It leaves very little opportunity, therefore, for a check on current costs.

If the shipyard has contracts to fill the ways for some time to come, and it is desirable to find currently the profit or loss on the contract amount, the scheme outlined above may easily be modified to show this information (see Fig. 2).

In this connection by finding the money return to the company of each workman's efforts and subtracting the cost (in labor, overhead and material) of this man to the company, we have a profit (if plus) or loss (if minus) per man. These data are interesting when an increase or decrease of forces is going on and will enable the management to know the effects of the changes.

SHIPYARD EMPLOYMENT MANAGERS' ANNUAL MEETING.—The annual meeting of the Employment Managers' Committee of the Atlantic Coast Shipbuilders' Association was held in Atlantic City, N. J., on June 27. Among the subjects discussed were the following: Relations of the Employment Department to the Management and to the Shop Personnel; Stabilizing the Working Force; Placement of Returning Soldiers, and many other topics relating to the work of employment managers.

Electric Propelling Machinery of the Battleship Tennessee

BY WILLIAM H. EASTON

The United States battleship *Tennessee,* launched on April 30 at the New York Navy Yard, Brooklyn, N. Y., is to be the most powerful fighting machine in existence. She will be able to shoot harder and stand more punishment than anything else afloat, and her speed will be sufficient to keep her in contact with any vessel of her class.

Her overall length is 624 feet; beam, 97 feet; draft, 31 feet; and full load displacement, 33,000 tons. She will mount twelve 14-inch guns; twenty-two 5-inch guns; two 3-inch anti-aircraft guns; four saluting pieces, and two 21-inch submerged torpedo tubes. Her armor protection, which is as complete as naval science can make it, consists of a 14-inch main belt of armor, reduced to 8 inches aft, and 3 inches at the deck ends, with special protection against torpedo attack. Her complement will be 1,119 officers and men.

Propulsion is by four propellers, each driven by an electric motor, power for which will be supplied by two turbine-driven generators. The maximum power will be 33,500 horsepower, and the maximum speed over 21 knots.

The Navy Department has experimented with electric drive for several years, and has decided to use it on the new battleships because, though not especially superior in reliability, weight per horsepower, economy, and speed range to the geared-turbine drive as adopted for the 90,000 horsepower scout cruisers, its use does permit greater freedom in the design of the ship. With geared turbine, the turbines and propellers are connected together by means of shafts and gears, and there is little leeway in the location of the engine room. With electrid drive, however, the turbines and propellers are entirely separate mechanically, and the former can be placed in almost any desired location. This flexibility is of special importance in battleship construction, for it permits greater consid-

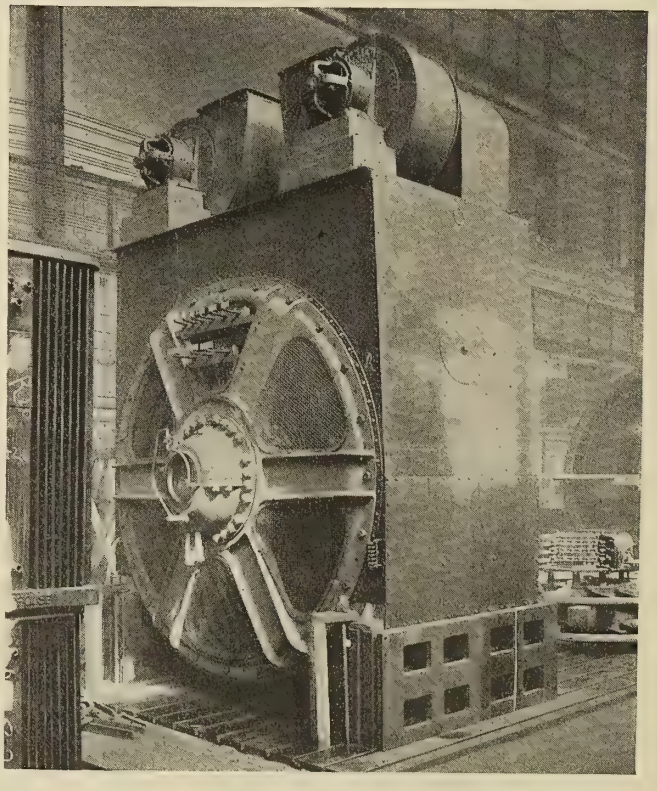


Fig. 1.—Thrust End of Propelling Motor, Showing Motor-Driven Ventilating Fans on Top



Fig. 2.—Sketch of the *Tennessee*, Made from Official Design

eration to be given to purely military factors, such as the arrangement of magazines and the protection of vital parts. In fact, owing to the freedom in the location of the bulkheads, it is possible to make an electrically-operated battleship practically torpedo proof.

In addition, the motors can be placed well aft, so that the length of the propeller shafts can be reduced to a minimum; and the turbines can be so located with reference to the boilers and condensers that the steam, oil, exhaust, and other pipe lines can be made as straight and short as possible.

The Turbines

The turbines of the *Tennessee* are of the Westinghouse single-cylinder, semi-double flow, impulse-reaction type. The high pressure steam first passes through a two-row impulse wheel in each turbine, and then through a section of reaction blading. It then divides into two equal parts, and each part passes through a low-pressure reaction section into the condensers.

The speed of the turbines can be varied through a range of from 1,500 to 2,270 revolutions per minute, by means of manually controlled hydraulically operated governors. The movement of the control handle varies the pressure in an oil system, and this in turn varies the loading of the governor and causes a change in speed. This system is superior to one in which the control handle and governor are mechanically connected, because there are no rods or shafts to jam where they pass through the bulkheads. A unique feature of this system is that the oil pressure is caused to pulsate, thus keeping the entire mechanism slightly in motion. This prevents sticking of the parts and adds greatly to the sensitiveness of the control, which is of great importance when ships are steaming in formation.

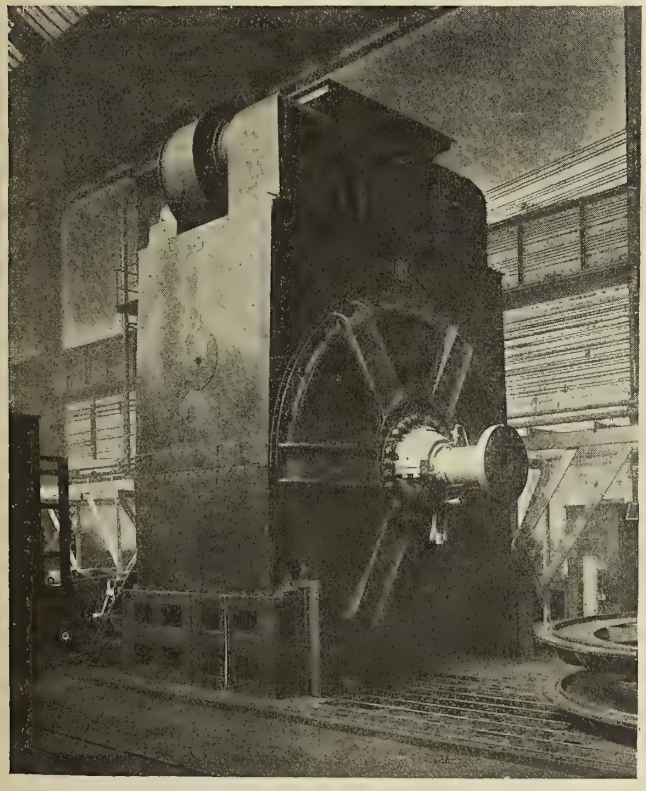


Fig. 3.—Propeller End of Motor

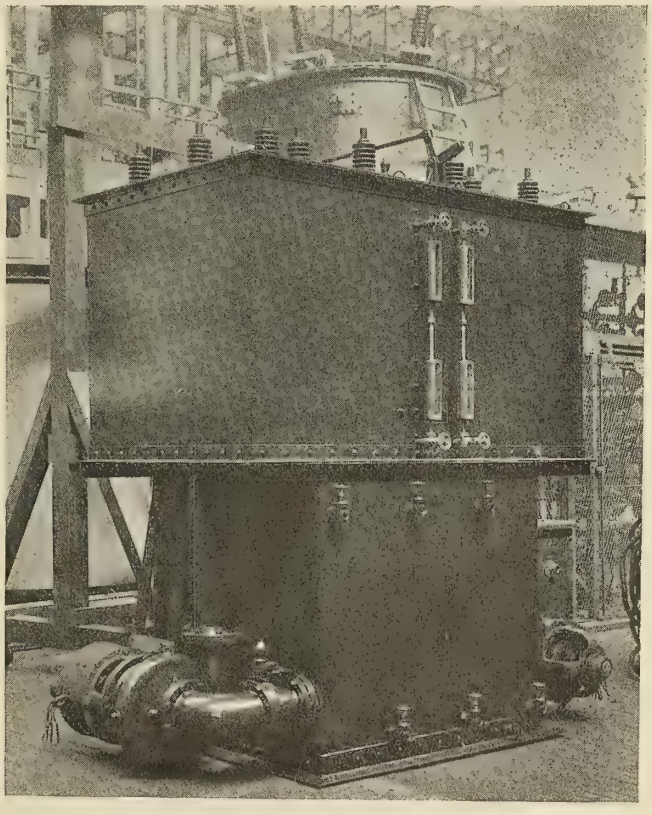


Fig. 4.—Liquid Type Rheostat

The speed of the turbines, as determined by the setting of the governor, remains practically constant regardless of the load, and hence the propellers do not race when they leave the water in rough weather. Automatic stops

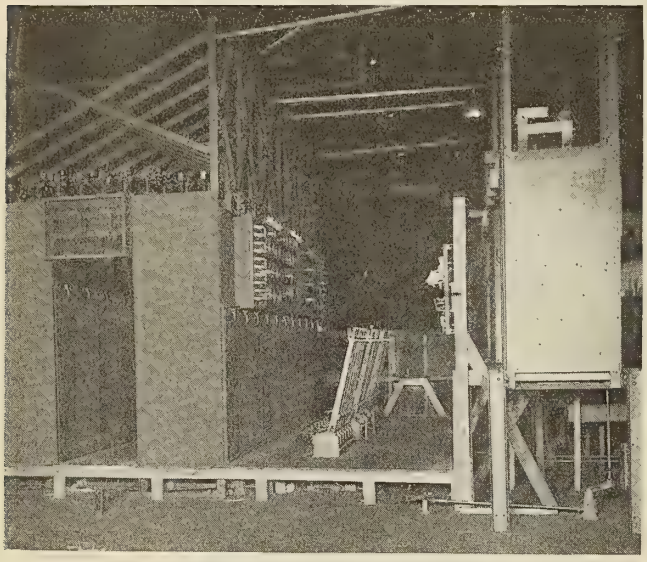


Fig. 5.—Control Station

are also provided, which cut off the steam in case the speed of the turbines exceeds a safe limit.

The Generators

The generators, which are directly connected to the turbines, are two-pole Westinghouse machines and supply the motors with 3-phase, 3,400 volt alternating current at frequencies ranging from 25 to 38 cycles, depending on the turbine speed. They are excited from the direct-current power supply of the ship, and each can develop 15,000 KVA at the maximum speed of the turbine.

The generator coils are very carefully insulated so as to prevent injury from high temperatures, moisture, and accumulations of salt. They are kept cool by air which is forced through the ventilating ducts by fans mounted on the rotor shafts.

The Motors

The four motors are of the Westinghouse induction type. They are directly-connected to the propellers, and each can develop a maximum of 8,375 horsepower continuously. To provide a sufficiently wide speed range, each has two windings, one of 24 poles and the other of 36 poles. The same result could have been obtained by the use of a single winding, but this would have involved greater complication in the connections and would have restricted the design in other ways. The 24-pole winding is connected to slip-rings on the rotor shaft, while the 36-pole winding has short-circuiting connections and is equivalent to a squirrel-cage arrangement. Both windings are used for running, but only the 24-pole for starting and reversing, resistance being inserted in series with it during these operations.

The insulation of the motors is similar to that of the generators, and ventilation is provided by means of two motor-driven fans mounted on the top of each motor.

Speed Control

The method of controlling the speed of the motors can be readily understood by considering that the 36-pole winding is equivalent to a gear of an 18 to 1 ratio between the turbines and the propeller, while the 24-pile winding is equivalent to a gear of 12 to 1 ratio. Hence when the 36-pole winding is used, the motor speed will vary from 83 to 126 revolutions per minute when the turbine speed is varied through its range of 1,500 to 2,270 revolutions per minute, and with the 24-pole winding, the motor speed range is from 126 to 186 revolutions per minute.

To control the speed of the ship, three different combinations are employed:

1. From 9 to 15 knots, the motors are operated on the 36-pole windings and all four are driven by one turbo-generator.
2. From 15 to 17 knots, the motors are operated on the 24-pole windings by means of one turbo-generator.
3. From 17 to 21 knots, the motors are operated on the 24-pole windings by means of both turbo-generators.

To reverse, two phases at each motor are transposed without changing the direction of rotation of the turbo-generators.

Steam Consumption

The use of one turbo-generator for the lower speeds assists in maintaining good operating economy by keeping the load on the generating unit close to its rated capacity except at the very slowest speeds. The steam consumption per shaft horsepower-hour, including that required for excitation, condenser operation, and motor ventilation, is as follows:

Speed in Knots	Motor-Poles	No. Turbo Units	Pounds of Steam.
9	36	1	16
15	36	1	12
15	24	1	13
17	24	1	12
17	24	2	12.4
19½	24	2	11.7
21	24	2	11.9

Control System

All the switching apparatus for controlling and distributing the power to the motors, for regulating the main turbines, and for controlling the excitation of the gen-

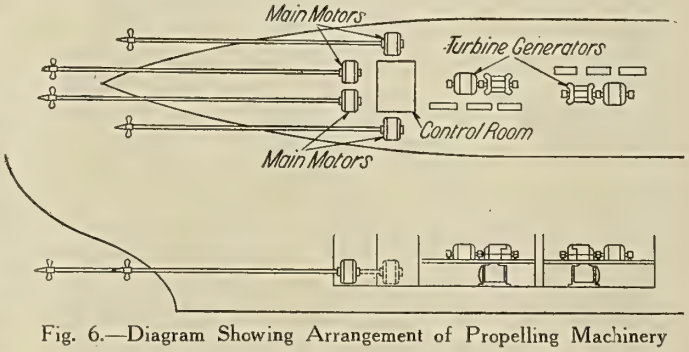


Fig. 6.—Diagram Showing Arrangement of Propelling Machinery

erators, is located in a central control room, where the operator has directly in front of him everything necessary for the operation of the equipment. Full advantage has been taken of the great facility with which electric current can be measured, inasmuch as the data thus obtained greatly assist in the operation of the ship.

The rheostats used for starting and reversing the propeller motors are of the automatic liquid type, in which the resistance is varied by adjusting, by means of a pump, the level of a liquid in which fixed electrodes are immersed. This type of rheostat, though not as yet extensively used by the Navy, has become very popular in industrial service because of its simplicity, compactness, and reliability.

The cables connecting the generators and motors are

of great importance because the operation of the ship depends upon their reliability. In order to insure the best possible type of construction, a committee of the American Institute of Electrical Engineers assisted the Navy Department in preparing the specifications for these cables. They are of the three-core type, and laid in a number of parallel circuits, so that the failure of any single cable will not seriously interfere with the operation of the ship.

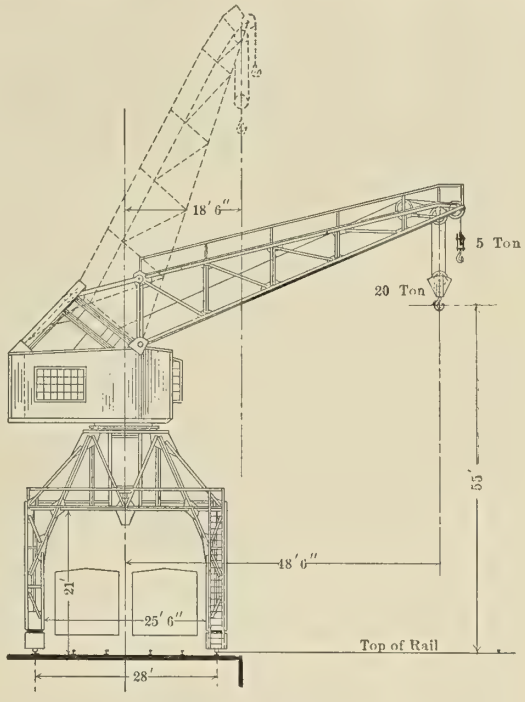
Auxiliaries

The main circulating pumps are of the centrifugal type and are operated by 235-horsepower motors. Their speed can be varied to suit conditions so that the power consumption can be reduced with the speed of the ship. LeBlanc air ejectors, which are novel in this class of ship, maintain a high vacuum in the condensers. The condensate is handled by motor-driven vertical centrifugal pumps. Thus, all the main engine room auxiliaries are rotary and are motor-driven, which, it is believed, will insure a higher degree of reliability than the use of some of the older forms of equipment.

Erie Railroad Pier Equipped with Revolving Jib Gantry Cranes

IN order to speed up the handling of freight on Pier *H* of the Erie Railroad at Weehawken, N. J., three revolving jib gantry cranes, of ten tons normal capacity, and one of twenty tons, have been installed by Heyl & Patterson, Inc., Pittsburgh, Pa. Originally Pier *H* was equipped with locomotive cranes, but these proved inefficient, so the pier was rebuilt to an open form, 1,000 feet long and 80 feet wide, with room for five parallel, standard gage, railroad tracks, and the four cranes. Two cranes span two sets of tracks on either side of the pier, so that one track is left free in the center. No obstruction to freight cars is caused by the cranes spanning the other tracks, however, and with this arrangement any of the cranes may reach all the tracks.

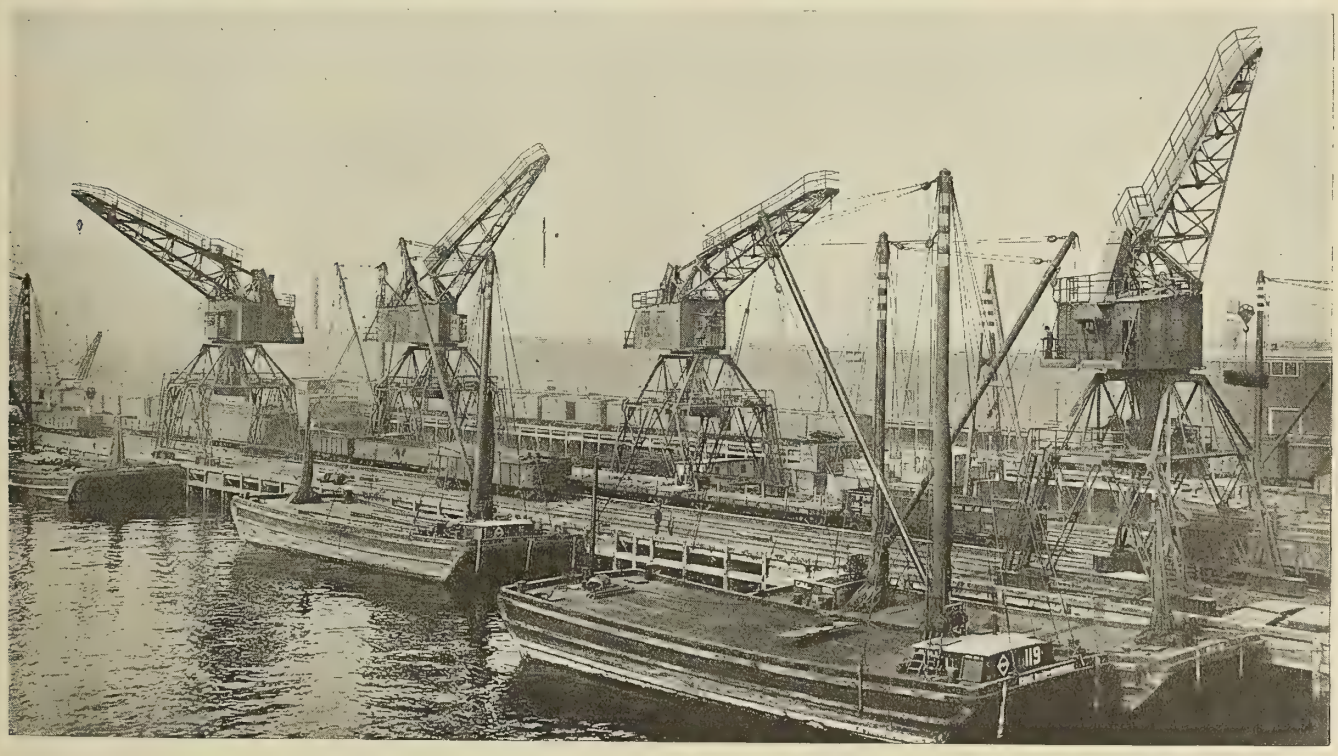
Each crane is equipped with three motors; one of 81 horsepower for the main hoist, one of 33 horsepower for rotating the boom, and one of 25 horsepower for the gantry travel. The current supplied is two-phase, 60-cycle alternating, at 2,300 volts, which is changed for use to a current having characteristics of six-phase, 188 volts



Details of Gantry Crane

potential, and this in turn is converted into a direct current of 250 volts, delivered to the contact rails on the pier. Current is collected from an under-running shoe on the contact rail.

The ten-ton crane has the following speeds: Main hoist, 220 feet per minute; slewing speed, 3 complete revolutions a minute; traveling speed, 150 feet per minute. The speeds of the twenty-ton crane are: Main hoist, 55 feet per



Pier H, of Erie Railroad, Weehawken, N. J., Equipped With Revolving Jib Gantry Cranes

minute; slewing motion, 2 complete revolutions per minute; traveling speed, 150 feet per minute. The hook lift distance in all cases is ninety feet.

The cranes are equipped with automatic magnetic brakes on the armature shaft of the motor, which hold the load whenever the power circuit is opened. In addition, a standard brake and friction clutch is provided in the drive to disconnect the hoisting drum and hold it stationary while raising or lowering the boom. A solenoid sets the clutch and releases the brake. Magnetic contactor type controllers give either power or dynamic braking, whichever may be necessary for lowering the empty hook, without any shift of the controller handle. Limit switches automatically prevent overhoist of the load.

Concrete Coal and Oil Barges for the Navy

Details of Construction and Launching of 500-Ton Barges Built by the Ambursen Construction Company, Inc.

THE Bureau of Supplies and Accounts, Navy Department, took bids on March 29, 1918, for twelve concrete barges to carry coal on deck or fuel oil in the hold. There were no plans and only very general specifications, each bidder making his own design to submit with his bid.

The contract for four vessels was awarded to the Ambursen Construction Company, Inc., of New York City, their design having been selected by the Bureau of Construction and Repair of the Navy Department as being the most satisfactory. Two of these barges have now been completed and delivered.

Main Particulars

The illustrations show the general appearance of the completed vessels, one of them being treated with waterproof paint and the other being left as it came from the forms.

The general dimensions are as follows:

Length on deck	112 feet
Length on bottom	83 feet
Width	36 feet
Depth in center	12 feet 3 inches
Depth at ends	13 feet 3 inches

The Navy Department describes these boats as "500-ton coal and oil barges." However, as they are designed to have an average freeboard of 3 feet 6 inches under this load, they will actually carry about 750 tons.

Three longitudinal and five transverse bulkheads divide the barge into compartments.

Bulkheads

All of the bulkheads are designed to withstand full hydrostatic head on either side. Eight large compartments along the centerline are to hold the cargo of oil, while others are for buoyancy only. For the alternative cargo of coal, flashboards are provided on deck five feet in height.

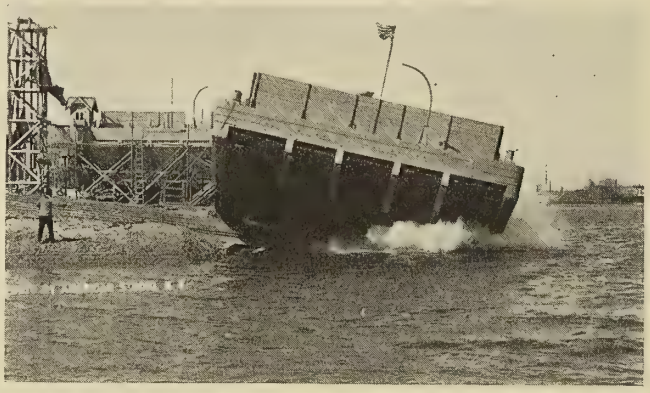


Fig. 2.—Launching of First Barge



Fig. 1.—General View of Ambursen Yard With Two Barges Nearing Completion on the Ways

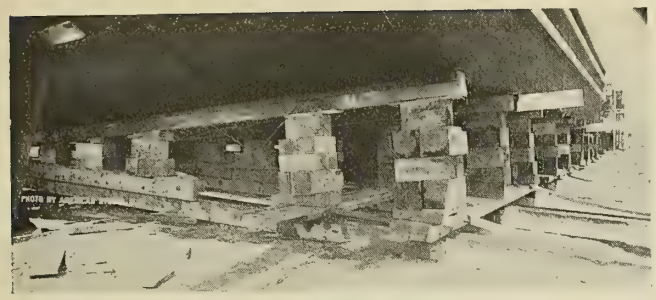


Fig. 3.—Launching Ways



Fig. 4.—Barge No. 433 Afloat

The general design is a 3-inch reinforced concrete slab on frames 16 inches deep, spaced 3-foot centers. This lay-out holds good for deck, sides and bottom. The bulkheads are also 3 inches in thickness and are stiffened with ribs 3 feet on centers on both sides. Gussets at all intersections provide ample stiffness.

Fig. 1 shows the general layout of the Ambursen yard with the two boats nearing completion on the ways. The concrete plant was located centrally between the two boats and concrete was delivered over a scaffold in wheelbarrows. Forms were made up at a carpenter shop about fifty feet back of the mixing plant with gasoline (petrol) driven woodworking tools.

Fig. 1 also shows barge No. 433 as she appeared when ready for launching. Fig. 4 shows this boat in the water immediately after her successful launching. Fig. 2 shows the same boat just as she went over the end of the ways at the launching.

The side method of launching was adopted and proved entirely successful. Fig. 3 shows how the launching blocking was arranged. The forward half of the boat was carried on slippers run longitudinally, as is customary in side launching, but under the rear, shoes were provided paralleling the groundways and with guides bolted on the sides to insure that the boat would be properly supported until she had cleared the ways.

Naval Construction During the War*

Light Cruisers of Arethusa Class and Subsequent Designs—Heavier Cruisers of 1915 Programme—River and Seagoing Monitors

BY SIR EUSTACE TENNYSON D'EYNCOURT, K.C.B.

FOLLOWING upon the previous light cruisers of the Town classes, the particulars of which have already been published, a very important departure was made in the light-cruiser design in the programme 1912-13, when the *Arethusa* class was designed by Sir Philip Watts. The importance attached to speed was specially brought out in this design, and it was decided to install very powerful machinery with a shaft horsepower of 40,000, and this could only be achieved by adopting a type of engines and boilers closely approximating to those hitherto used for destroyer classes.

In conjunction with high speed a good armament was provided, consisting of two 6-inch and six 4-inch guns, though in the original design the armament consisted entirely of 4-inch. The ship's sides up to the level of the upper deck were protected by specially high tensile plating varying from 2 inches to 1½ inches and 1 inch, throughout the machinery spaces, in addition to the 1-inch shell plating. This arrangement of plating also greatly added to the strength and stiffness of the ship regarded as a girder. Further particulars of the class are given in the table (see page 391, June issue).

The *Arethusa* and other light cruisers were in the action off Heligoland on August 28, 1914, and gave an excellent account of themselves.

In the 1913-14 programme the *Calliope* class, slightly larger vessels than the *Arethusas* but with the same power, were decided upon. After considerable discussion regarding the merits of mixed or homogeneous armament, it was decided to give these vessels two 6-inch guns, both on the centerline placed aft, and eight 4-inch guns. The protection consisted, as in the previous design, in a 2-inch belt over the shell plating, making a total thickness of approximately 3 inches. Most of this class had practically the same machinery as the *Arethusas*, but Parsons geared turbines were installed in two of them, the *Calliope* having four shafts and the *Champion* having only two shafts. This was at the time a very important experiment, the putting of 20,000 horsepower through gearing being a very bold departure from anything which had been hitherto contemplated. The final results obtained with *Champion* were, however, excellent, and she obtained a speed of 29½ knots with 337 revolutions and about 41,000 shaft horsepower, this speed being slightly in excess of any of the other vessels of the class at corresponding displacement.

For the subsequent classes I would refer to the tables, which show a gradual growth in size and power of armament; *Ceres* class finally having a length of 425 feet and a beam of 43 feet 6 inches, and a normal displacement of about 4,200 tons. These vessels carried five 6-inch guns, all on the centerline.

The next class were the *"D's,"* the general arrangement and protection of which followed that of the *Ceres*, except that 6-inch guns were carried on the centerline instead of five. The power was only slightly increased in these ships over the previous classes, but the revolutions were reduced to 275, all of these later classes having the twin-screw geared arrangement, and although the displacement of the *"D's"* increased to 4,650 tons, the additional length

*From a paper read before the Institution of Naval Architects, London, April 9. **Continued from June issue.**

and the reduction of revolutions enabled a speed of close upon 30 knots for the whole class of light cruisers, *"C's"* and *"D's,"* to be practically maintained.

The *Arethusas* and the *"C"* and *"D"* classes all had oil fuel only.

In addition to these light cruisers, which were all to Admiralty design, two vessels—the *Birkenhead* and *Chester*—which were built at Messrs. Cammell, Laird's for the Greek Government, were purchased in 1915. These vessels were considerably heavier than the *"C"* class and more closely resembled the British *Chatham* class. They carried an armament of ten 5½-inch guns. The machinery was modified to burn oil only, in the *Chester,* instead of coal and oil as in the *Birkenhead,* and the resulting increase in power to 31,000 gave the former a speed of 26½ knots.

The "Raleigh" Class

In the summer of 1915 designs were prepared for a considerably heavier class of light cruisers, more especially designed for ocean work in any part of the world. They were to have a speed of 30 knots and a large radius of action. Various armaments were considered, and it was finally decided to adopt an armanent of seven 7.5-inch guns with twelve 3-inch (four being on high-angle mountings). Five of the big guns were placed on the centerline, and the other two were on the broadsides amidships. The bow and stern guns were superposed, thus giving a fire of four guns, both ahead and astern, and six guns on either broadside. The conditions laid down involved a ship of great length, and these vessels consequently have an overall length of 605 feet. These ships were originally designed to burn oil and coal, but this was subsequently altered in three ships of the class to all oil, the original power of 60,000 shaft horsepower on a four-shaft geared turbine being considerably increased up to about 70,000 shaft horsepower by the change to all-oil firing.

These vessels also differed from the light cruisers referred to above in having modified bulges as protection against underwater attack. The form of the section shows how these were arranged. The protective plating was similar to that of the other light cruisers.

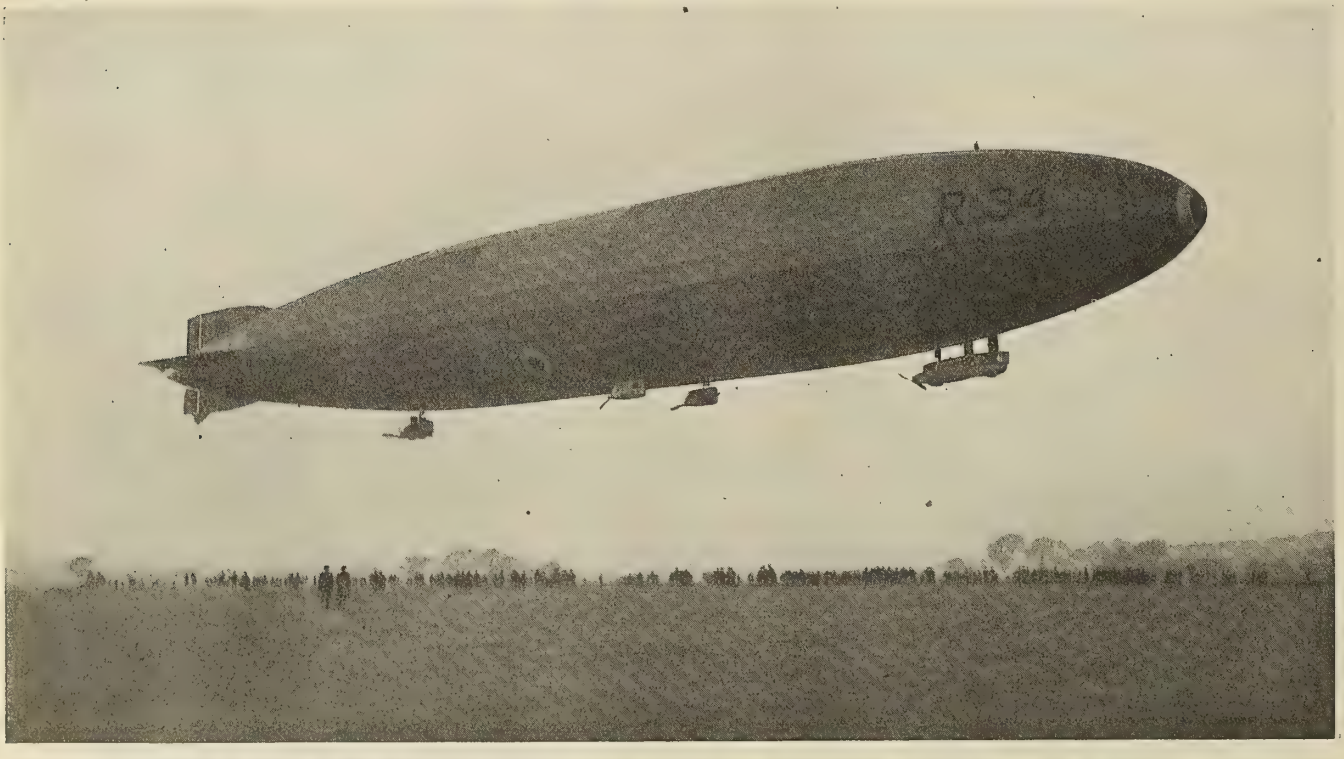
Monitors

The first vessels of this type to be added (or reintroduced) to the British Navy were three three ex-Brazilian river monitors built by Messrs. Vickers, Ltd., and taken over by the British Government in August, 1914, and renamed *Humber, Mersey* and *Severn.* The particulars of these vessels are given in the table, from which it will be seen that the armament consisted of medium caliber guns, viz., 6-inch and 4.7-inch. These vessels, though lightly built, have done very good service in the war, both on the East African and Belgian coasts.

The need for vessels of the monitor type mounting heavy guns soon became apparent, and I received instructions in November, 1914, to prepare designs of monitors of more substantial structure for sea-going service, but of light draft with good protection and carrying some heavy guns, the light draft combining the advantages of being able to go close inshore and greatly reduce risk of being struck by a torpedo.

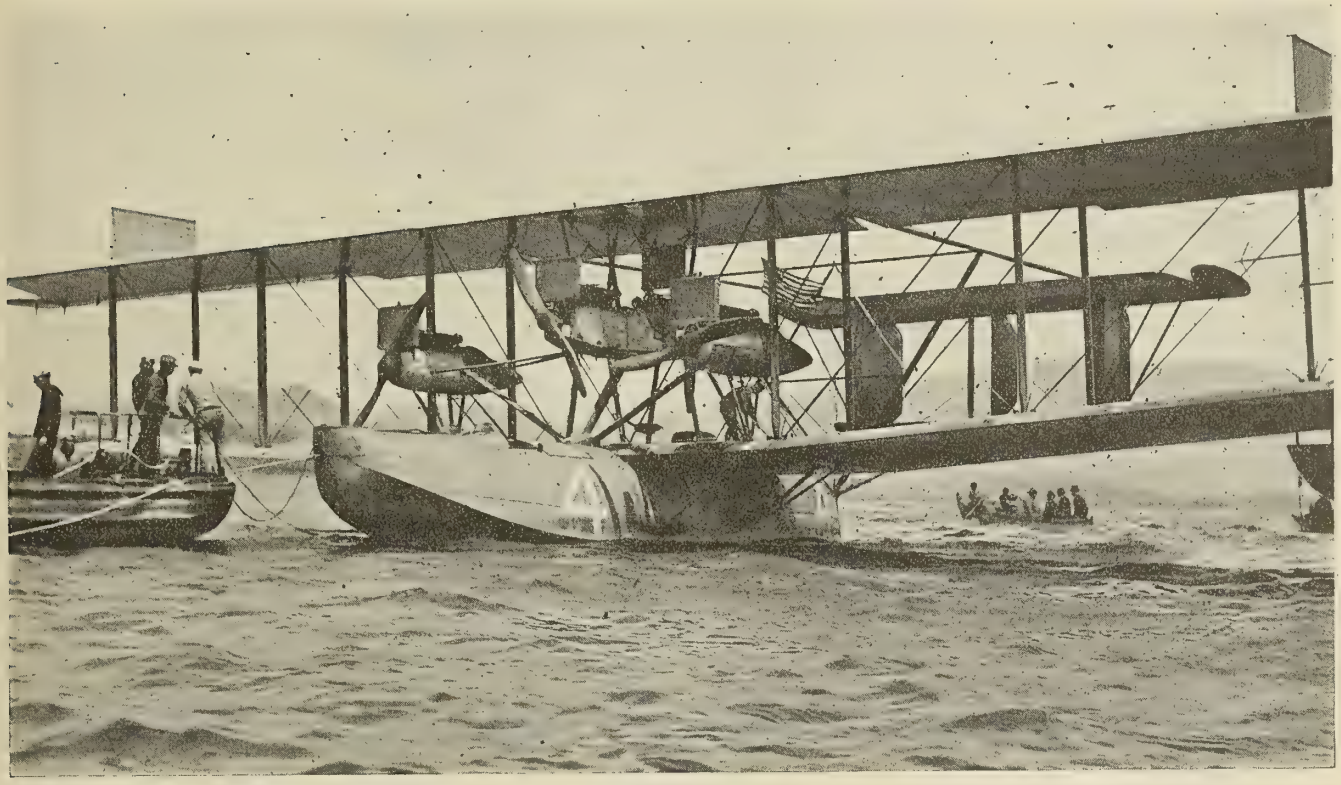
The earliest design was that of the 14-inch gun monitors, four in number, which was commenced in 1914. Four twin-mounted 14-inch guns and mountings were available, and with the very simple form of structure adopted these vessels were designed and built in six months. They were quickly followed by the 12-inch monitors, which were of similar design but carried pairs of 12-inch guns, generally taken from older battleships. These vessels were also built in about six months. They all had a complete bulge of a form which was of simple construction.

(To be continued.)



British Dirigible *R*-34, Built at the Beardmore Airship Works, Inchinnan, Renfrewshire, Scotland, for the Admiralty. This Giant Airship, which is About 650 Feet Long by 80 Feet Diameter, with a Lifting Capacity of Over 30 Tons, is Fitted With Sunbeam Engines Capable of Driving the Craft at a Speed of 70 Miles Per Hour. A Transatlantic Flight is Contemplated Early This Month

United States Naval Aviators the First to Fly Across the Atlantic Ocean



(Official Photograph, U. S. Naval Air Service.)

United States Naval Seaplane *N. C.* 4, the first Airship to Cross the Atlantic



(Official Photograph, U. S. Naval Air Service.)

The *N. C.* 4 at Ponta Delgato, En Route from New York to Plymouth, England

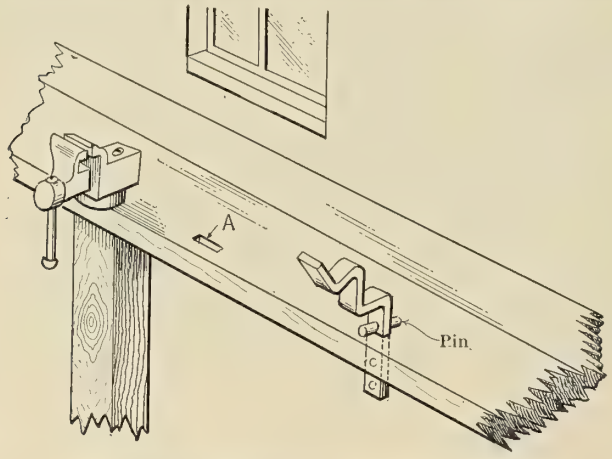
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Vise Work Support for Bench

The drawing shows a very handy easy-to-make type of long work support to use on the edge of the work bench at any desired distance from the bench vise. The support is made from ⅝ by 2-inch flat bar stock, being simply



Arrangement of Support for Vise Work on Bench

heated and bent to the shape shown and several holes drilled in the leg to take the upright adjusting pin. Slots are cut as at *A* along the outside of the bench at about 2 feet apart, thus allowing the support to be quickly changed to suit the work. W.

Leaky Valves

It sometimes happens that a valve after it has been installed (especially a large valve in an installation subject to high pressures and large ranges of temperature), no matter how carefully overhauled and ground to perfect fitness on the valve seat, still continues to leak.

When the valve is constructed and ground the metal is not in the normal condition of use; that is, it is not in the condition of temperature and strain due to contact with hot or very cold fluids, or pressure of the valve disk against the seat. The fit being made when the metal is cold, the valve and valve seat will become distorted as soon as the temperature of the metal rises, and the distortion, if equal all around, will be uniform and the fit preserved, but if unequal no amount of grinding will remedy it.

The tongue of metal on which the valve seat is cut is subject to the most distortion, due to the fact that its shape admits of expansion, which is mostly in a linear direction, and where there is considerable difference in the lengths of the tongue around the valve body the valve seat will become hilly or out of round. Such troubles are very common in high pressure compressor valves of large diameter with V-shaped seats. The temperatures in compressors take a wide range and come very high, so that if inequalities occur in the amounts of metal projecting from the valve body, the distortion will be very marked and extremely troublesome in high pressure work. Large capacity compressors working at high pressures can be found in numerous cases with valves of such faulty construction, and, possibly, design.

The writer has had experience with a valve on a steam steering engine closing against the pressure that somehow or other could never be made tight. Apparently nothing was wrong with the valve, but upon analysis of the trouble it was found that, due to inaccessibility of one side of the valve, it was left uncovered by lagging on one side, which subjected it to considerable cooling. It was suggested that this caused unequal distortion; but this idea was laughed at as being improbable, no appreciable distortion taking place. However, the argument prevailed, and the valve was completely lagged on the outside, which remedied the trouble like magic.

Air compressor valves with seats constructed in the cooling jacket with unequal distribution of metal will have their seats distorted in this manner. In one case of a 10-inch boiler stop valve the distribution of metal was so unequal that reseating and grinding was of no avail, that being repeated many times. Finally steam coils were made to wind around the valve body and the valve was heated to approximately a working temperature, then reseated and ground while the metal was in the heated condition. This took out the hills and oblique condition of the valve seat, and even when the valve was cold there was apparently enough spring in the disk to shape itself to the valve seat, which obviously must have contracted to an oblique shape upon cooling.

The effect of mechanical strains, such as the pressure of the valve disk on the seat, as a rule is taken care of in the design; but even then a valve may sometimes be found with weak or very springy metal, so that when the valve disk sets heavily on the seat it will spring it away from the ground fit. A good remedy for such a condition is to round off the top edge of the valve seat, because, when a valve is ground it usually leaves a shoulder on the valve disk that will catch on the sharp edge of the seat and not allow the disk to go down into the taper, and, should there be any spring in the valve seat, a tight fit can still be maintained by the approximate ball joint.

A grave source of trouble with spring loaded valves is in springs that do not stand up vertically, thus settling the disk down unevenly, causing an uneven wear on the valve in intermittent working, such as pump valves. Relief valves are subject to such troubles and, in addition, in this kind of valve, and particularly where steel valve stems are used, the valve will blow at different pressures other than that at which it was set. This is generally caused by corrosive material being scraped into the socket of the valve in which the valve stem rests every time the valve lifts, thereby changing the tension on the spring by the grit coming from under or getting under the valve stem.

Usually very little attention is paid to this part of the

valve in boiler safety valves, so much so, that in some cases the valve and stem are frozen solid, the man overhauling the valve thinking that it was meant to be so. The pressure of the spring being several tons was enough to dislocate the valve stem from its apparently fixed position in the valve socket every time the valve lifted, thus putting a new tension on the spring.

New London, Conn. W. H. Springer.

Testing Watertube Boilers

The writer has recently had under his charge the testing of some eighty or ninety new watertube boilers, and the preparing of same for steaming conditions. As the method adopted has been very successful, and may also be applied to some other classes of watertube boilers, these notes may be of interest.

First, a general idea of the boilers under consideration will be given, and then the three following items discussed:

1. Character of test required.
2. Preparing for and carrying out test.
3. Preparing for steam.

The boilers referred to above were of the Yarrow type: Steam drum, 50 inches diameter by 12 feet long; water drums, 30 inches by 12 feet long; number of tubes, about 3,500 of 1-inch diameter, except the three inner rows on each side, which are 1¼ inches in diameter; average length, about 8 feet.

The steam drum carries four safety valves bolted to pads and riveted on the shells. The front head carries the main stop valve, surface blow, two water gages, three try cocks and the auxiliary feed valve. The internal auxiliary feed pipe, scum pipe and steam-dryer pipe are fitted in the drum. The manhole is 16 inches by 12 inches.

The water drums (front heads) carry the main feed valves, and one drum is fitted with a salinometer cock. Each drum has an internal feed pipe arranged in a casing so as to cause a forced circulation. Blow-down valves are fitted to the shell of each drum. The manholes are 16 inches by 12 inches. Each boiler was capable of giving 7,000 horsepower, burning oil in a closed fire-room.

Character of Test Required

The character of the test required is as follows: Drums and tubes are to be tested to 400 pounds cold water pressure for one hour. The boiler, complete with all mountings, to be tested on board to 330 pounds cold water pressure for a period of six hours, a loss of eight pounds being the limit allowed in this time.

It will be readily admitted that such a test is severe and calls for careful preparation.

Preparing For and Carrying Out Test

As they come from the shop the boilers are usually in a very dirty condition; oil and grease from the tube expanders, chips of metal, scale, rivet heads, etc., are sure to be found in plenty. The oil need not trouble us at this stage, but all particles of metal, or anything liable to damage the valves, must be thoroughly blown out with an air hose; also each individual tube should be blown in order to ensure that it is clear. The boiler valves, though new, should all be taken apart, cleaned, and given a rub with finest emery to ensure a perfect seat. It is impossible to lay too much stress on the fact that this work must be faultless; a drop, however slight, is enough to spoil a perfect test.

After all the valves have been attended to, the safety valves may be gagged, the manhole doors carefully put on, air cock opened and the boiler filled slowly. For obtaining the best results all the air should be driven out, and this is sometimes a difficult matter. The air cock is usually fitted to the top of the drum, but a certain amount of air is trapped in the safety valves and in the main stop if this rises much above the level of the top of the drum. However, the amount trapped is small, and it is preferable to allow it to remain rather than to open the valve, as there is sure to be some little particle of grit in the water that may lodge on the seat and necessitate regrinding.

Having the boiler full, we may proceed to pump up by the hand pump to about 100 pounds. At this pressure it is well to make a thorough examination of the boiler, looking to all seams, rivets, mountings and tubes. Any leaky tubes can be easily detected by a long lighted taper passed between the rows. Assuming all is well, the pressure may be increased to 200 pounds, and later to 250 pounds, a good examination being made at each pressure. The manhole doors will probably require a little tightening up by this time.

If any fittings should be found porous they must be dealt with as experience dictates. A very small leak may be stopped by peening with a hammer or by a calking tool, care being taken to relieve the pressure first. If a casting is spongy it should be removed and a new one fitted in place. Valves not exposed to steam, as, for instance, the main feeds, may be tinned, if necessary.

Let us now assume that all is satisfactory and that the pressure on the boiler has been raised to 330 pounds without any leaks. We can relieve the pressure and prepare the boiler room for the final test.

All gages to be used should be calibrated and large gages should be used, so that a drop of even half a pound may be noted. Boiler room hatches should be closed or covered with canvas, and all openings in bulkheads plugged up, in order that the boiler may not be subjected to any draft. Stacks must also be covered, and all openings to the furnaces closed.

When this is done, and the necessary thermometers, etc., are in place, the inspector may be called, the boilers pumped up to the full pressure, and the hand pump locked or disconnected.

Readings should be taken every half hour. If it is desired to gage any part of the boiler while under test, suitable arrangements must be made beforehand.

The writer took some measurements of the boilers both before the pressure was applied, and while it was on, with the following results: After a 400-pound test on the shell and tubes (all openings for fittings being blanked) the part faced for the main stop showed a permanent distortion of thirty-seven thousandths, and the faces for water gage fittings as much as twenty-five thousandths. All these faces had to be scraped up again before fitting the mountings. Before applying the 330-pound test with mountings in place, measurements were taken between port and the starboard water gage fittings (top) and found to be 24 inches. While the pressure was on, this showed 24¼ inches. The fittings were bolted to extensions on the head about 8 inches long. A tram was also made from the boiler shell to the top of the main stop spindle, and under this pressure showed a difference of ⅛ inch. The head was ¾-inch thick.

Preparing For Steam

After the test has been passed, we may proceed to clean the boilers, as follows: Having emptied them and removed the bottom manhole doors, we put into each bottom drum 25 pounds of soda, 6 pounds of lye and 5 gallons of coal oil. Replace the manholes and put in enough water to fill

the bottom drums. Then connect a temporary steam pipe to the bottom blows and admit steam carefully at about 40 pounds pressure. The steam will condense, and, in time, bring the water to the boiling point.

When the pressure on the boiler is approaching that of the incoming steam, the surface blow may be slightly opened to maintain a pressure of 25 or 30 pounds. The condensation of steam will soon fill the boiler to the level of the scum pan, and all oil and grease will be removed in this manner.

Boiling is continued about 70 hours. At the end of this time, the boilers may be emptied and allowed to cool and then the manual part of the cleaning will commence. The tools required are few and simple: Wire hand brushes, tube brushes, wire cables fitted with sockets into which the tube brushes are screwed, scrapers, and a bale of rags, are all that we require.

First the internal pipes are removed and the top drum brushed down thoroughly with the wire brushes, care being taken to clean well around the tube ends. Sometimes there is a little mill scale found on the heads, especially around the flange, and this can be removed with scrapers. It is not well to try to chip it, as the head must be left as smooth as possible.

When this is finished, the tubes may be started. The wire brushes should be wrapped with rags, as this leaves the tubes in a fine polished condition, whereas a wire brush alone makes them look streaky. The brushes will only clean the parallel part of the tubes, and the bell-mouth must be "poked" by means of a stick wrapped with rags.

After this is done, the drum and tubes may be blown out with the air hose, and then the bottom ends of the tubes "poked" in a similar manner and the bottom drums wire-brushed, and, if necessary, washed with coal oil.

As soon as the bottom drums are finished and attention has been given to all the small outlets for water gage fittings, etc., which are easily choked up, the boiler may be inspected by the chief engineer of the ship, who should, in the case of straight-tube boilers, "sight" every tube from the top drum, while his assistant holds a light at the bottom. If the inspection is satisfactory, the internal pipes may be cleaned and replaced, and the boiler filled to the working level with distilled water.

Should the boilers not be required for any considerable time, it is better to fill them right up to the air cock with slightly alkaline water, or they may be left dry and a tray of burning charcoal introduced into each bottom drum and the boiler closed entirely.

San Francisco, Cal. A. BLUNDUN.

Two Handy Kinks

In the course of time there accumulates around the shop a lot of solder scraps, short ends of bars, and drops of solder that run off the work, etc. These should be saved up in a box and when a sufficient quantity accumulates melted and re-cast into bars.

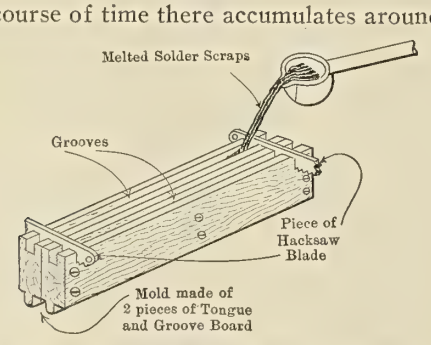


Fig. 1.—Mold for Casting Bars of Solder

Very satisfactory molds for the purpose can be made by obtaining a couple of pieces of tongued and grooved boards. Nail them together, as shown in Fig. 1, and use a couple of old hack saw blades for dams at the ends; just saw the blades in crosswise and leave them there.

A useful, cheap and easily made cotter key extractor can be made from an old file, as shown in the sketch,

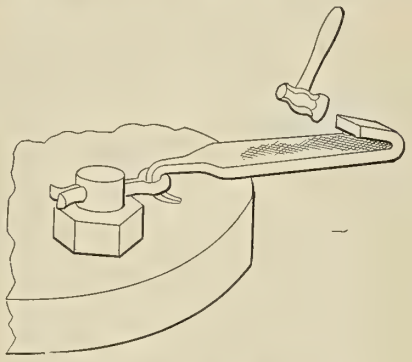


Fig. 2.—Cotter Key Extractor

Fig. 2. The tang is bent hook shape and the other end of the file is heated and bent back on itself, about as shown. For using the tool, hook the tang in the eye of the cotter key and strike blows of the hand hammer on the bent-up end of the file. C. H. WILLEY.

NEW BOOKS

RULES AND INSTRUCTIONS FOR THE INSPECTION OF MARINE MACHINERY. Size, 4 inches by 7 inches. Pages, 143. Philadelphia, 1918: United States Shipping Board Emergency Fleet Corporation. Price, $1.

A handbook giving general instruction for the inspection of reciprocating steam engines, Diesel type engines, turbines, reduction gears, watertube and Scotch boilers, pumps, condensers, refrigerating machinery, propellers and auxiliaries.

PRACTICAL SHIP PRODUCTION. By Lieutenant-Commander A. W. Carmichael, U. S. N. Size, 6 by 9 inches. Pages, 252. Illustrations, 101. New York, 1919: McGraw-Hill Book Company. Price, $2.50.

Designed as an aid for beginners in shipyards, this book describes briefly the various parts of a vessel, the problems involved in the design of a ship, the features and equipment of a shipyard, and finally the various operations of building a ship. No attempt is made to go into the theoretical questions of ship design or construction, but rather to give a practical manual for shipyard workers and officials.

THE NAVAL ARCHITECTS, SHIPBUILDERS AND MARINE ENGINEERS POCKET-BOOK. By Clement Mackrow and Lloyd Woollard. Twelfth edition. Size, 4 by 6½ inches. Pages, 760. Illustrations, 268. New York, 1918: The Norman W. Henley Publishing Company. Price, $6.

Mackrow's handbook was materially enlarged and the data brought up to date in the last edition, which was published in 1916. In the new edition the opportunity has been taken to correct a few errors that had arisen in the previous editions and to add in the form of an appendix supplementary notes referring to various sections of the book. Of chief interest in the new material is an article on estimating the weight and cost of a merchant vessel, contributed by Mr. Colin Bartlett, of the staff of the chief ship surveyor of Lloyd's Register. This will be found of particular value in small shipyards where a definite system of estimating costs is not yet in operation.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Boiler Spares

Q. (1008).—Acting as second engineer, I am told to prepare a vessel having Scotch boilers for a long voyage. What spares would it be advisable for me to carry for such a trip?

A. (1008).—If the boiler is old, it would be advisable to have half a dozen boiler tubes, one dozen zincs, half a dozen manhole and handhole gaskets, a spare check valve, one-half dozen gage glasses with washers, a spare safety valve spring, stem and disk, one set of grate and wing bars, baffle plates and fire bucket. The above spares are for one boiler only.

Bilge Suction Lines

Q. (1011).—We have had trouble aboard my ship with getting bilge suction lines clear. Our coal cargo seems to sift through and get into wells where it clogs the strainer and prevents the pump from working. At times the water will accumulate in the hold due to raining in with the hatch covers off, and it is very difficult to get at the strainer. Can you suggest any remedy? ASSISTANT.

A. (1011).—I suppose you have tried flooding back. If this is done, make sure that all non-return valves are removed. In one case, to my knowledge, there were three non-return valves which had to be removed before it was possible to flood back. Usually there is a strainer in the manifold which should be cleared, as it will be found full of fine coal. The best remedy, of course, is to keep the bilge wells clean, which should be done regularly by the deck force and inspected by the first assistant.

Attached versus Independent Pumps

Q. (1012).—Kindly inform me concerning the advantages and the disadvantages of attached versus independent pumps, with special reference to the air pump. B. H. S.

A. (1012).—The attached pump has the following advantages, viz., few working parts, no steam cylinder, requires little attention or regulating and is probably cheaper. Being driven by the main engine the efficiency of its drive is undoubtedly higher than in the case of the independent pump.

The point in favor of the independent auxiliary is that its speed can be regulated to correspond with the power exerted by the main engine, and, further, the handling of main engine is easier, as the vacuum is maintained while the engine is at a standstill.

Division of Work in Engine Department

Q. (1013).—I am desirous of obtaining information in regards to the duties of the different engineers aboard ship and the machinery under their special care on single-screw ships, also on ships of two or more screws. I have been told that you could furnish me with this information. If so, I will deeply appreciate your help in this line.

A. (1013).—In single-screw American merchant steamers it is usual to have four engineers; the only exceptions are very small steamers, such as trawlers or certain passenger steamers, where the run is not more than ten or twelve hours. When there are four engineers the chief does not stand watch except in case of an emergency, but he, of course, is held responsible for the work of his department and the making out of logs, repair lists, requisitions, etc. The first assistant has active supervision over all work done in the engine room, his especial care being to supervise the overhauling of the main engine and auxiliaries, in which he is helped by the third assistant. The cleaning and upkeep of the boilers and boiler room are generally left in the hands of the second assistant. A deck engineer whose particular duties are the upkeep of winches, etc., is sometimes carried, but commonly this work is left to the third assistant. For high-powered, twin-screw merchant steamers the work is laid out in much the same manner, although junior engineers are sometimes carried who aid the assistant engineers and usually stand watch in fireroom.

Economical Speed

Q. (1014).—How is the economical speed of a vessel correctly calculated?

A. (1014).—To answer your question fully would require a lengthy reply, which might not even then be complete, for the economical speed may be construed in several different ways, viz.: The maximum distance with the minimum fuel consumption. The speed above which an increase in power does not show a reasonable increase in speed, a matter of prime importance in warship design. In deciding the most economical speed of a merchant ship, several factors enter into the earning power of a vessel, all of which may be covered by the requirement that the net income be the maximum.

A solution of the economic speed problem may be secured in the following manner:

Let V = speed in knots.
D = length of voyage in nautical miles.
C = total cost of operation for voyage, i.e., overhead charge plus propelling cost.
F = overhead charge per hour which may be considered as being made up of wages of crew, depreciation, interest on investment, stores, coal consumption in port, miscellaneous expenses which are incurred when vessel is not running.
C' = net cost of propulsion per hour, and may be assumed to vary as V^3 or $C' = KV^3$.

$$C = KV^3 \frac{D}{V} + \frac{D}{V} F. \qquad (1)$$

To find the minimum value of C, take the derivative of C with respect to V and equate to zero.

$$2KV - \frac{F}{V^2} = 0.$$

$$V^3 = \frac{F}{2K}. \qquad (2)$$

The most economical speed may be obtained by solving equation (2), the value of K being obtained from equation (1), as we must know the value of C' for one speed.

While the above solution seems straightforward, its practical application is by no means easy. Some very interesting articles have recently appeared on this subject. Among these a paper by John Anderson before the Institution of Naval Architects, 1918, also article in MARINE ENGINEERING for 1916 on pages 81 and 316.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

INTERNATIONAL MERCANTILE MARINE DEAL VOTED DOWN

Stockholders by Seven to One Vote Show Disapproval—Firm to Continue on Old Basis

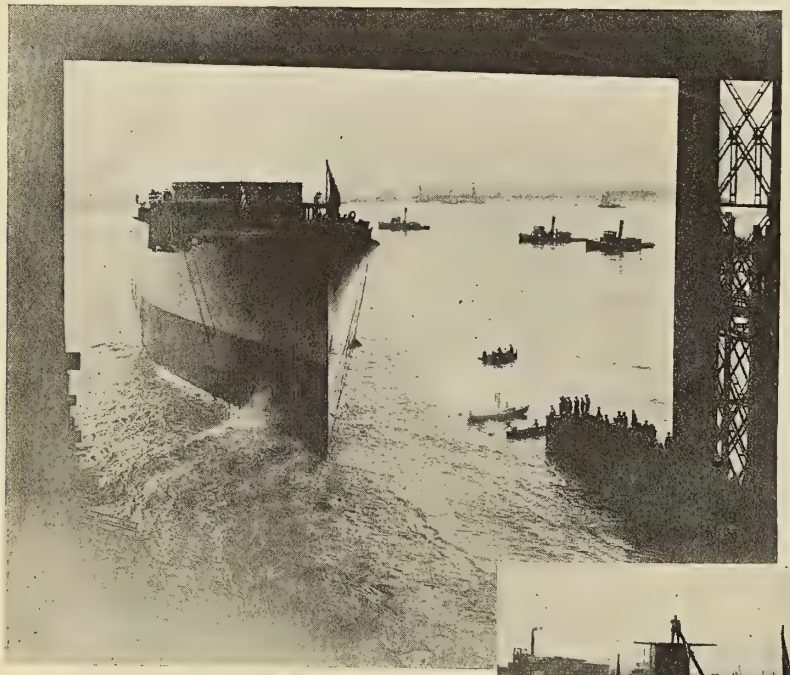
By an overwhelming vote the stockholders of the International Mercantile Marine Company have turned down the offer of $130,000,000 made by a British syndicate for the fleet and assets of the company's British subsidiaries. The vote on the sale stood 78,521 preferred and common shares for, and 530,072 preferred and common shares against.

After the stockholders' meeting at which this action was taken, P. A. S. Franklin, president of the International Mercantile Marine Company, announced that the company would continue to do a regular shipping business, and that the future development of its American flag fleet would depend upon the United States Government shipping policy.

The killing of the motion to accept the offer of the British syndicate ends a long period of uncertainty regarding the future of this concern. Since November, 1918, negotiations for the disposal of the British subsidiaries of the company have been under way, and it was only after the Shipping Board took its hands off that matters came to a head.

Arthur Kill Marine Terminal

Plans are now being prepared by H. McL. Harding, terminal engineer, New York City, for the development of four terminal units, each 600 feet in frontage and about 1,300 feet in width on the Arthur Kill, Staten Island Sound, N. J. The estimated cost of the facilities and equipment is about $1,200,000.





New York Shipbuilding Corporation Has Double Launching

On May 24 the New York Shipbuilding Corporation, Camden, N. J., launched the transport *Wenatchee* and the United States destroyer *Gilmer*. The keel for the latter was laid June 26, 1918, the transport was laid down on June 15, 1918. Both covered and open ways are in use at the yards. The torpedo boat destroyer *Fox*, illustrated on on the opposite page, is also a New York Shipbuilding Corporation product.

BRITISH SHIPPING MINISTRY ASKS FOR $427,500,000

Shipbuilding Transfered to Private Concerns

In the light of Chairman Hurley's recommendations to Congress regarding the advisability of ownership and management of the American merchant fleet by private capital, and the request for additional appropriation to carry out the Shipping Board's plans, the following data concerning the problem as handled on the other side are enlightening.

The status of the British shipbuilding programme is indicated by the report submitted by Leslie O. Wilson, Parliamentary Secretary of the Ministry of Shipping, showing that expenditures for Government shipbuilding activities would total about $427,500,000 for 1919. Shipbuilding reports at this time are as follows: Up to May 6, 240 standard ships had been completed with a gross tonnage of slightly over 1,000,000 tons. At the signing of the armistice the Ministry had on service 283 Government ships. The Government was building, or had on order, 595 ships of 3,800,000 tons.

The speed with which the Government has cancelled contracts and disposed of ships is therefore evident. One hundred and fifty-nine ships have been taken over by the builders or cancelled. Under an agreement with Lord Inchcape, 249 contracts were taken over for distribution, without any profit to Lord Inchcape to those British owners who desired them in proportion to their losses. The British, therefore, through these private individuals, have stabilized the shipbuilding industry by underwriting the contracts and so carrying the programme to completion.

A further 68 ships have been sold to British shipowners and 57 to foreign countries. The sale price of these latter vessels amount to £19,600,000. The contract price for these vessels amounted to £16,500,000.

Rahway River Terminal

On the north bank of the Rahway River, which empties into Staten Island Sound, it is planned to construct a terminal of about 5,900 feet frontage by 900 feet in depth.

The terminal will be divided into units, eleven of 500 feet frontage and one of 400 feet, the latter being a barge quay for the use of all the units.

H. McL. Harding, terminal engineer, of New York, has been retained to prepare the plans. The estimated cost of the construction is about $2,400,000.

AMES COMPANY BUILDS 18,000-TON DRYDOCK AT SEATTLE

Six-Pontoon Construction Operated by Electrically-Driven Pumping Apparatus

Construction has been begun on the first two pontoons of an 18-000-ton drydock which the Ames Shipbuilding & Dry Dock Company, Seattle, Wash., is constructing on a site north of its present yards. Work will be begun on the second set of pontoons after the first of July. Each of the pontoons will have a lifting capacity of 3,000 tons. Over 1,000,000 feet of lumber will be used in the construction of each pontoon. These may be utilized in separate units or in any other arrangement desired.

The drydock will have a total length of 540 feet, which will accommodate a ship 650 feet long. The work is being carried out under the supervision of C. J. Carlson, owner of the Carlson yard in Port Blakeley. The pontoons, which will be self-docking, will be fitted with 50-foot towers. Electric-driven pumping apparatus will be installed.

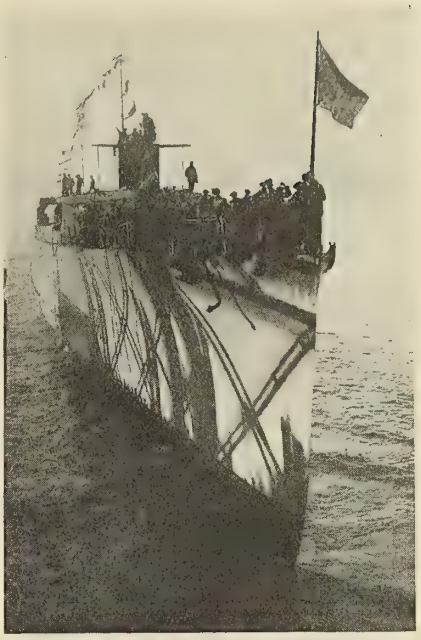
Comprehensive Marine Engineering Course at Lehigh University

The Lehigh University incorporates in its 1919 curriculum a new course covering ship construction and marine transportation. As planned, the work will combine economics and engineering, with a view to training "all around" engineers for this field. Economics, accounting, finance, business law, foreign exchange, industrial management and marine insurance have been included. It is hoped that graduates, after having had experience with shipbuilding companies in designing and building ships, will through this broader college training be able to enter the foreign trade field. An innovation along the newer educational lines has been introduced by a substitution of a class in construction for the usual freshman English, in order to give the students early contact with engineering.

Everett Shipyard Ready for Construction Work

The Everett, Wash., plant of the Norway-Pacific Construction & Dry Dock Company, which holds a contract to build five single screw cutters for the Coast Guard Service is nearing completion.

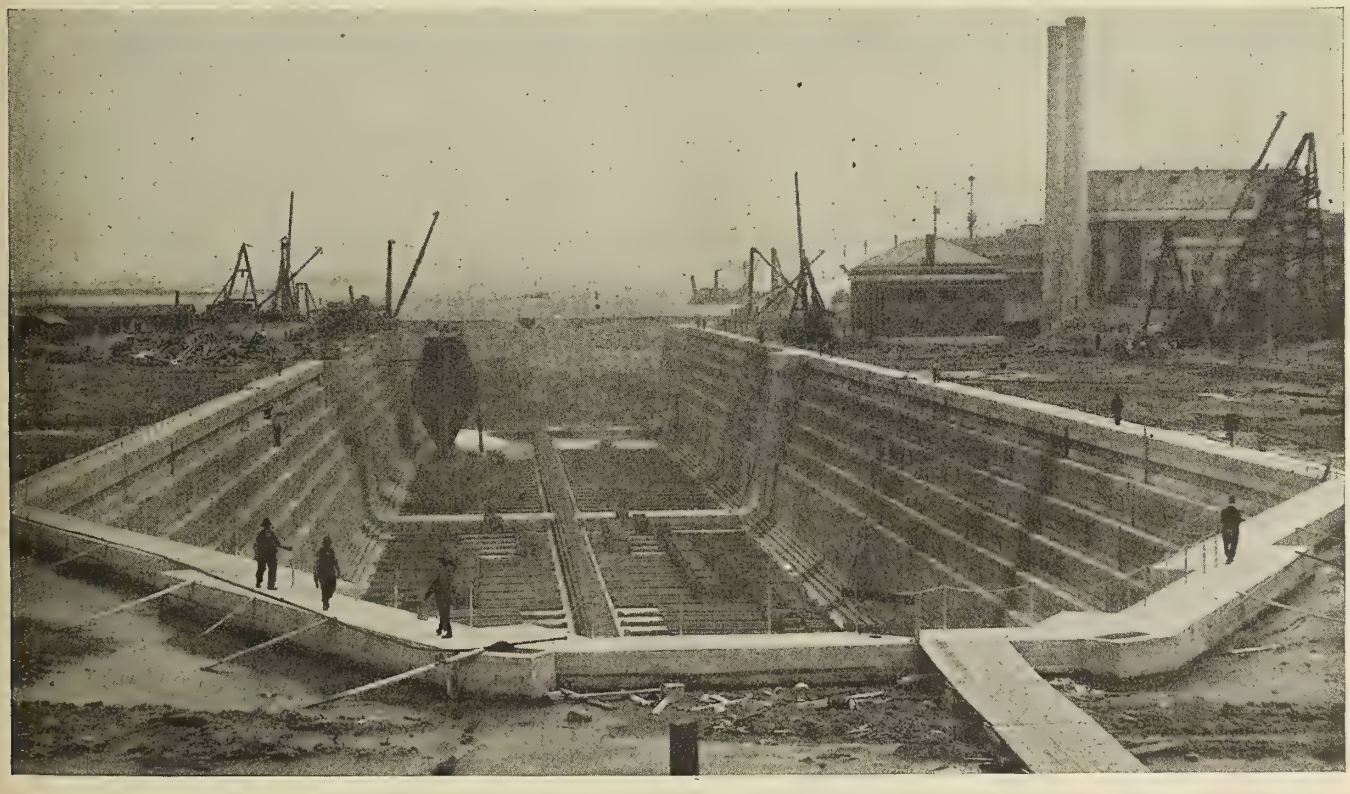
As originally planned, five shipways, 490 feet in length, to accommodate vessels up to 18,000 deadweight tons, were to be built. Following the signing of the armistice only three ways were constructed. The plant is provided with a fabricating shop, 600 feet long by 101 feet wide, with a mold loft 350 feet by 100 feet. The machinery has already been installed in this building. The boiler house, power house and oxy-acetylene welding plant are also ready for operation, as well as the administration, engineering, employment and hospital buildings, etc. A special storehouse, 150 by 300 feet in size, with a smaller mold loft overhead is also completed.



United States Torpedo Boat Destroyer *Fox*, Built at the New York Shipbuilding Corporation Yards

Field's Point Plant Gains Large Contract

Announcement has been made that large contracts for boilers are about to be placed with the Field's Point plant of the Bethlehem Shipbuilding Corporation. This work will keep the Providence, R. I., plant opened for at least another year. S. W. Wakeman, manager of the Fore River plant, Quincy, Mass., was summoned to Washington to negotiate for the contract.



View of the $3,000,000 Boston Drydock Which is Nearing Completion

Emergency Fleet Corporation Increases Drydock Facilities in the United States

Information concerning the docking facilities in service or contracted for on May 20 was issued by the United States Shipping Board on May 28.

The increase in ship repair facilities as developed under the Emergency Fleet Corporation, may be noted from the tabulation below, which shows complete and incomplete drydocks along all coasts. As may be noted from the figures, a total tonnage capacity of 106,400 tons is provided by twelve marine railways and seven floating drydocks. Two graving docks, 465 feet in length, are not included in the estimate. Including projects upon which work has not yet been completed, this gives a total of 150 separate units for repair work. Since this information was given out, new repair plant projects have been announced.

New $6,000,000 Repair Plant for Norfolk

Work will soon be begun upon the $6,000,000 ship repair plant of the Hampton Roads Dry Dock & Ship Repair Corporation at Lambert's Point, near Norfolk, Va. James Stewart & Company, Inc., 30 Church street, New York, it is reported, will receive the contract; and since much of the equipment necessary for construction operations is already in the district, work can be started at once.

The construction plans include one 4,000-foot bulkhead, three piers, 900 feet long by 75 feet wide, one drydock to accommodate 10,000-ton vessels, one drydock to accommodate 15,000-ton vessels, twelve buildings, including administration offices, machine shops and foundries. It is said that the actual construction work has been estimated at about $6,000,000.

Private'y Own d	Graving Docks Length 261 to 300	300 to 400	400 to 500	500 to 650	650 & Over	Floating Dry Docks Tons 1500 to 2500	2500 to 3500	3500 to 5000	5000 to 8000	8000 & Over	Marine Rwys. Tons 1500 to 2500	2500 to 3000	3000 to 4000	4000 & Over	Total
New England District	..	..	1	..	1	..	..	..	1	..	7	1	1	..	12
North Atlantic District	..	..	1	1	..	17	6	3	4	8	1	1	..	1	43
Delaware River District	..	1	1	..	..	..	1	..	..	..	1	1	..	..	5
Middle Atlantic District	..	..	1	5	1	2	..	..	..	..	5	..	..	..	14
Southern District (4)	..	..	..	..	..	..	..	1	1	..	1	..	..	..	3
Southern District (5)	..	..	..	..	..	2	..	2	1	..	..	..	..	..	5
Southern Pacific District	..	..	..	..	2	1	1	1	1	2	1	..	..	6	15
Oregon District	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Northern Pacific District	..	..	..	..	..	..	..	2	..	4	..	..	1	..	7
Great Lakes District	..	6	6	6	3	..	..	1	..	1	1	..	..	..	24
Total		7	10	12	7	22	8	10	8	16	17	3	2	7	129
United States Shipping Board Emergency Fleet Corporation															
New England District	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2
Middle Atlantic District	..	..	2	..	..	..	..	..	..	1	..	..	1	..	4
Southern Atlantic District (4)	..	..	..	..	..	..	..	..	1	1	..	3	..	..	5
Southern Atlantic District (5)	..	..	..	..	..	..	..	..	..	2	..	1	..	..	3
Gulf District	..	..	..	..	..	..	..	..	..	2	..	1	..	..	3
Southern Pacific District	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2
Oregon District	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Northern Pacific District	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Total	..	..	2	..	..	..	..	..	1	6	..	8	2	2	21

EMERGENCY FLEET PROGRAMME

District	Contractor	Location.	Capacity.	Complete or Incomplete.
New England	Crowninshield S. B. Co.	S. Somerset, Mass.—M. R	2 500 T.	C
	Cumberland S. B. Co.	Portland, Me.—M. R.	2,500 T.	C.
North Atlantic	Marine Eng. & D. D. Co.	Providence, R. I.	3,200 T.	I.
*Delaware River	American Dredging Co.	Camden, N. J.—M.R.	2,000 T.	I.
Middle Atlantic	Bethlehem S. B. Corp.	Sparrows' Pt., Md.—D.D	20,000 T.	C.
	Geo. Leary Constr. Co.	N. Y., Norfolk, Va.—Twin G. D.	465' Length	I.
Southern (4)	Tampa Dock Co.	Tampa, Fla.—M.R.	2,500 T.	I.
	Federal Marine Rwy.	Savannah, Ga.—M.R.	2,500 T.	I.
	Terry & Brittain	Savannah, Ga.—D.D.	8,000 T.	I.
	Terry & Brittain	Jacksonville, Fla.—D.D.	6,000 T.	I.
	Terry & Brittain	Jacksonville, Fla.—M.R.	2,500 T.	I.
Southern (5)	Alabama D.D. & S.B. Co.	Mobile, Ala.—D.D.	10,000 T.	I.
	Jahncke S. B. Co.	New Orleans, La.—D.D.	10,000 T.	I.
	Henderson S. B. Co.	Mobile, Ala.—M.R.	2,500 T.	C.
Gulf	Beaumont S. B. & D. D. Co.	Beaumont, Tex.—D.D.	8,000 T.	I.
	Galveston D.D. & Const. Co.	Galveston, Tex.—D.D.	10,000 T.	I.
	Beaumont S.B. & D.D. Co.	Beaumont, Tex.—M.R.	2,500 T.	C.
Southern Pacific	Barnes & Tibbitts	Alameda, Cal.—M.R.	2,500 T.	I.
	Barnes & Tibbitts	Alameda, Cal.—M.R.	4,000 T.	C.
Oregon	Astoria Marine Iron Works	Astoria, Ore.—M.R.	4,000 T.	I.
Northern Pacific	Puget Sound M. R. Co.	Tacoma, Wash.—M.R.	3,200 T.	I.

Shipbuilding at the Consolidated Shipbuilding Corporation's Yards

The Consolidated Shipbuilding Corporation, the new name of the Gas Engine & Power Company and Charles L. Seabury & Company, Con., Morris Heights, N. Y., is engaged in very diverse types of construction. For example, the company is building a 230-foot steel steam yacht, two 74-foot motor yachts, a 45-foot shallow draft tunnel stern boat and four 100-foot wooden harbor tugs. The company is also building an 86-foot yacht and a 52-foot stock cruiser. In contrast may be mentioned the mine sweeper *Tern* recently delivered to the Government—the fifth vessel of this type built by the company.

New Line of Agrippa Turning Tools

A new line of set screw pattern turning tools with right- and left-hand offsets and straight shanks is being placed on the market by J. H. Williams & Company, Brooklyn, N. Y. This company manufactures drop forgings and drop-forged tools at its plants in Brooklyn and Buffalo, N. Y. The company's line already includes a wide range of sizes of Agrippa tool holders for all regular machining operations. Several of these styles are fitted with a cutter-fastening device using a cam instead of the usual set screws, as illustrated. The cams are furnished with hexagonal head, or are headless.



Agrippa Turning Tool Holder

The nose of the holder of either cam or set screw turning tools is beveled to permit its use in close quarters. The tools are drop-forged and carefully heat treated. The cutter-holding channel is broached to accurate size, and

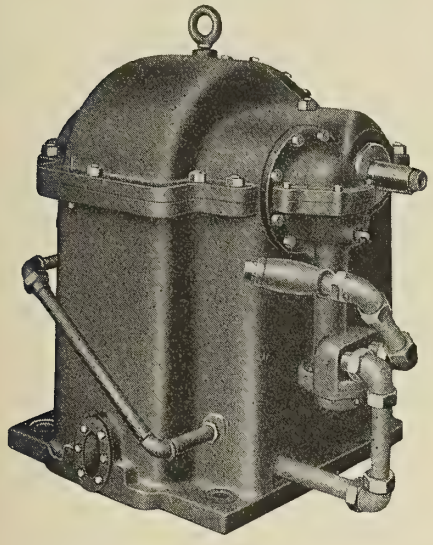


Set Screw Pattern Tool Holder

accordingly provides a rigid seat for the cutter. For usual mill practice the makers recommend turning tools of the cam fastening pattern. However, since this arrangement limits the range of contact, the makers are offering the new line of set screw pattern turning tools. The "diamond point" form or bevel of Agrippa cutters provides for all ordinary requirements with a minimum of grinding for either right- or left-hand usage.

Terry Reduction Gears

Terry reduction gears, which have been unavailable during the past year for public sale because of their use in connection with turbines for destroyers of the United States Navy, are again being placed on the market by the Terry Steam Turbine Company, Hartford, Conn. The Terry gears and pinion, which are of the stub-tooth, double-

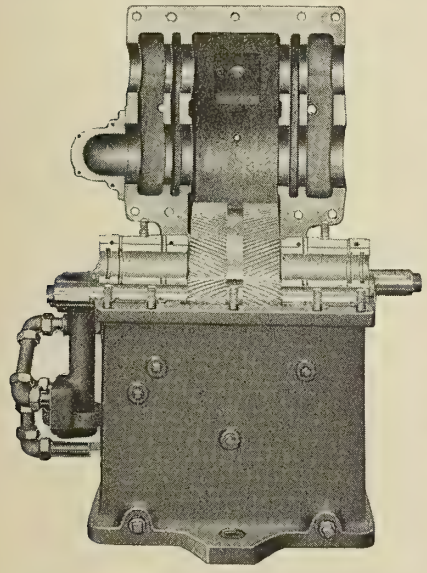


Complete Set of Terry Speed Reduction Gears

helical type, are generated to true form on a Fellows gear shaper. The gears and pinions are interchangeable.

A ribbed, double-walled, box-like structure, extending the full depth of the case, forms a rigid support for each pair of bearings. The space between the walls acts as a water jacket for cooling the oil, while the ribs between the walls serve both as stiffening members and water baffles. The central part of the case, directly under the gears, serves as an oil reservoir, holding sufficient oil to supply both gears and turbine.

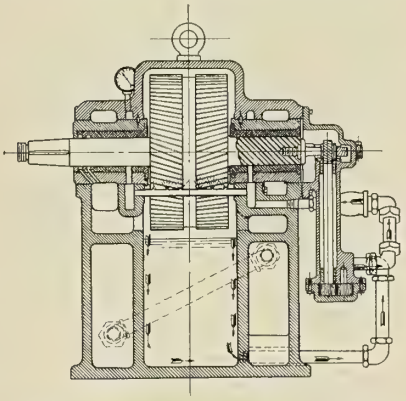
The forced feed oil system is em-



Reduction Gears With Case Removed

ployed. The pump is located well below the oil level in the reservoir, which arrangement avoids suction lift, thereby preventing destruction of the gears in case the pump fails to function. From the reservoir the oil is pumped through direct brass piping to a self-cleaning strainer, thence through distributing passages to large annular oil pockets around each bearing shell, and through the spray pipe from which the oil is sprayed in lubricating the gear teeth. The oil pressure gage is located in one of the annular oil pockets at the point most distant from the oil pump.

The pump and its bevel gear drive form a complete unit without stuffing boxes or exposed running parts. The pump gears may be removed for inspection without disturbing the driving



Sectional View Showing Relation of Pump to Gear

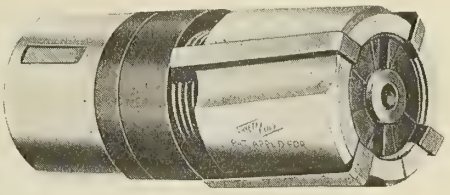
mechanism or oil piping. The bevel gears may also be inspected by removing a small cover. In the water cooling system, which is supplied with all standard equipment, the cooling jackets are located in the bearing ends of the case, so that the heated oil draining from the bearings and gears at once comes into contact with the cooling surfaces before it has had time to heat the oil in the reservoir.

New Expanding Reamer

The Wetmore expanding reamer illustrated is a commercial development of an adjustable type reamer, supplied by the Wetmore Reamer Company, Milwaukee, Wis., to shell manufacturers in the United States and Canada during the war. The left-hand spiral cutting angle of the blades is probably the most advantageous feature of the design, and is clearly shown in the illustration.

In production work of any kind, such as shell, automobile or gear making, where speed in cutting and accuracy are essential, it is claimed that this reamer is of special value. Adjustments to required limits may be made by means of a special wrench provided to manipulate a graduated screw collar in the reamer body. Each graduation on the screw collar indicates one thousandth of an inch in the diameter. The body of the reamer is solid and may be attached to any arbor, although arbors for various machine operations are provided.

Standard reamers are made in sizes from 1 inch to 4½ inches, and blades

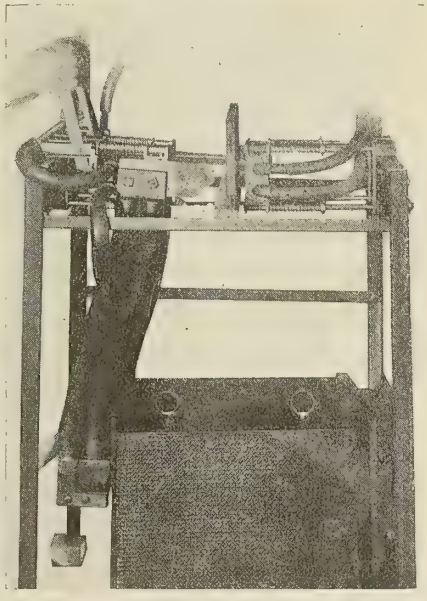


New Wetmore Expanding Reamer. Note Left-Hand Spiral Cutting Angle of the Blades

are packed so that they may be conveniently stored and identified. Four blades are used on reamers up to 3 inches in size, and six blades on larger ones.

Electric Rivet Heating Device

An electrical heating device for rivets, which may be used as an attachment on "bull" or gap riveting machines or on portable hand riveters, has been produced by the United States Electric Company, New London, Conn. For use with "bull" riveters the device is arranged so that a hot rivet is kept in front of the plunger during the riveting operation. The rivets are placed in the rivet holes cold, and the work to be riveted is moved along in front of the electrodes, which may be brought in contact with the rivets either by the motion of the plunger or by the use of a hand lever. The attachments are built to heat rivets of ¼ inch to 1¼ inches in diameter. On recent tests two ¾-inch rivets, with 2½-inch shanks, were heated in 15 seconds; two ⅞-inch rivets, with 2½-inch shanks, in 23 seconds, and two 1-inch rivets, with 2½-inch shanks, in 30 seconds.



New Rivet Heating Device Used With Gap Riveting Machines or Hand Riveters

The electrodes are so constructed that two rivets may be heated at once in about the time generally required to heat one. This is accomplished by bringing one rivet to the proper heat, while the other is being pre-heated, so that a continuous line of hot rivets is kept on the way to the plunger of the gap riveter at all times during the operation.

ATTACHMENT APPLIED TO PORTABLE RIVETING MACHINE

In the case of portable riveting machines the device is designed for use with rivets not over ⅝ inch in diameter. It is made to operate in conjunction with the pneumatic hammer.

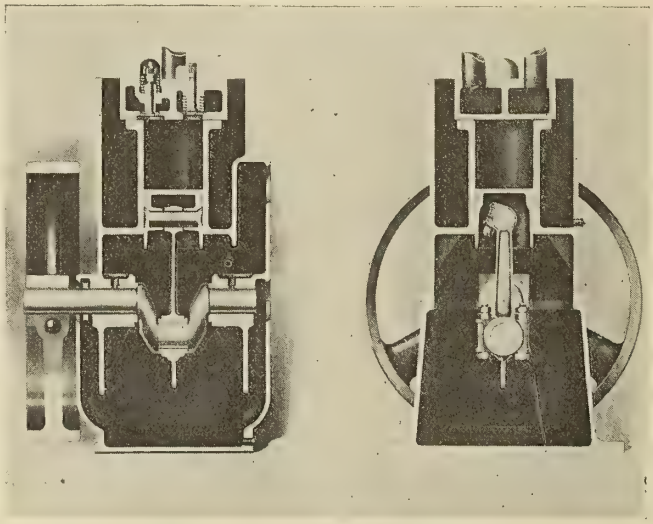
The operation is rather simple, the tool being attached to either the riveting hammer or the holder-on. Cold rivets are placed in holes shaped to size, the holder-on comes in contact with the rivet as in an ordinary case, but here the electrode is brought in contact with the head of the rivet. Heat is maintained until the desired intensity is reached, then the rivet is headed by turning the air gun around.

The electrode is attached to the side of the riveting gun, allowing two rivets to be heated at once by the use of a bridging conductor, which makes the device useful in heading rivets from one side of a plate, the outside of a boiler or in restricted spaces. Equipments are available in all sizes and for use with 110-volt and 220-volt currents.

Imperial "Fourteen" Small Air Compressor

On April 15 the Ingersoll-Rand Company, 11 Broadway, New York, placed on the market a small air compressor of new design, known as the Imperial Fourteen. These new standard compressors, which are built in four sizes, provide a capacity ranging from 3 to 45 cubic feet per minute at pressures to 100 pounds per square inch, although they can be used for pressure requirements up to 200 pounds by increasing the horsepower. They are single-acting, belt-driven machines of the vertical type. Where they are designed to be driven from a line shaft, however, tight and loose pulleys are supplied. When designed to be used with an independent motor, they are furnished as a unit complete with the motor, endless belt and short-drive attachment. In the latter case, a hardwood base plate is included.

The smallest size is built with an air-cooled, ribbed cylinder for intermittent service, and with water-cooled cylinder of the reservoir type for continuous operation. The larger machines are water-cooled only; in the case of the largest size, a closed jacket for connection to the pressure system is optional.

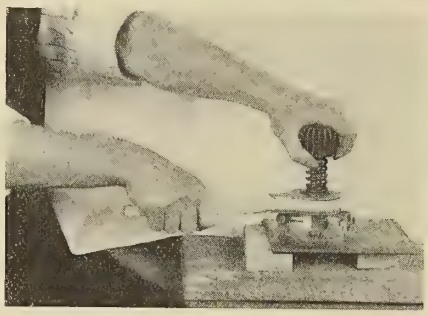


Section of Imperial 14 Compressor

Electric Trucks Being Used in San Francisco for Cargo Handling

As the result of successful experiments conducted by the Pacific Mail Steamship Company at its San Francisco piers, other shipping concerns in the city are arranging to utilize electric labor-saving equipment on their piers.

The Toyo Kisen Kaisha plans to introduce electric trucks on Pier 34, and has requested that the flooring of the pier be leveled by the Board of State Harbor Commissioners and that the pier be wired. The Matson Navigation Company at the same port is wiring Piers 30 and 32, so that they may utilize electric-handling machinery.



Cutting Tool in Operation

Submarine Boat to Produce Large Power Diesel Engines

The 1918 report of the Submarine Boat Corporation, which is associated with the New London Ship & Engine Company, specialists in Diesel engine building, contains the following statement:

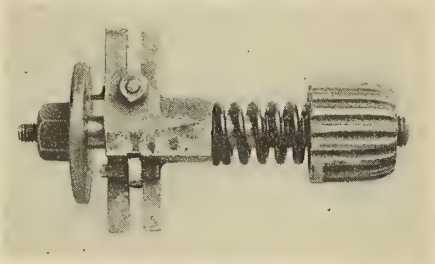
It is expected that during the coming year Diesel engines of large power will be produced by us which will create a large business for the manufacturing facilities of the company, and may require additional plants for the manufacture of such Diesel engines in quantity. * * * The commercial value of the large Diesel engines for the operation of cargo vessels has been demonstrated by certain engines of European design, and we believe that these results can and will be fully equaled, if not excelled, by the engines to be produced by this company.

Portable Cutting Tool

As a portable tool for cutting large holes in places where the acetylene flame might not be entirely practical, the adjustable cutter illustrated below should be of value to the shipbuilder. The cutter consists of a chuck holding two cutting tools adjustable for various diameters from 1¼ to 6 inches. Pressure is applied to the cutting tools by means of a heavy spring. A ratchet wrench is used to rotate the chuck to cut a round, clean hole through steel plates up to ½ inch in thickness. Since this Jiffy cutter, which is put on the market by Koch & Sandidge, Chicago, Ill., is light, it will be found very handy on board ship for cutting holes in electrical cabinets, metal lockers and through bulkheads. It will also be found of value in the shipyards for emergency work while ships are in the process of being assembled.



Former Hand Method



Portable Cutting Tool

$25,000,000 Terminal Development for Berkeley, Cal.

The first details of a vast project for terminal developments in the Berkeley tidelands, Berkeley, Cal., have recently been made public. According to reports the improvements include the building of a huge pier 3,000 feet wide and extending 18,000 feet into the bay from the present high water mark.

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEWS OF SHIP CONTRACTS

The Providence Engineering Company, Providence, R. I., has received a contract from the United States Shipping Board to construct and equip ten steel tugs, each 150 feet long. The hulls are being built at City Island, N. Y. Five of the vessels are to be oil burners and the others will use coal.

C. C. Galbraith & Son, 90 West street, New York, has received a contract to furnish three 28-foot boats to the Lighthouse Department, Tompkinsville, N. Y.

The Gothenburg Shipbuilding Company, Gothenburg, Sweden, has received a contract to build eight new motorships for the Transatlantic Shipping Company. The vessels are to be 440 feet long, 54-foot beam, with a load draft of 26 feet.

The Motorship Construction Company, Vancouver, Wash., has received a contract from the Union Fishermen's Co-operative Packing Company, Astoria, Ore., for the construction of a small concrete barge, 58 feet long, 24 feet beam and 6 feet deep.

The Canadian Dominion Government has awarded contracts to Canadian shipyards for forty-five steel ships. These contracts amount to about $42,000,000. In addition to these ships the yards are at work on foreign contracts.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., opened bids on June 18 for furnishing a 12-inch hydraulic steam-driven dredge at Paris Island, S. C.

The Bertelsen & Petersen Engineering Company, East Boston, Mass., has received a contract to repair the Russian bark *Professor Koch* in 48 days. The work will cost about $60,000.

The Merrill-Stevens Company, Jacksonville, Fla., is building a large oil barge for the Mexican Petroleum Corporation. The barge is 150 feet long, 30 feet wide and 5 feet deep. Propelling engines will be installed.

W. K. McKean, Tufts Cove, Halifax, N. S., is building a 155-foot tern schooner.

The Howse Construction Company on the Meteghan River, N. S., is at work on a 155-foot tern schooner.

The National Shipbuilding Company, Orange, Tex., has begun the construction of ship No. 15 on the new contract which is held from the Emergency Fleet Corporation.

The Texas Steamship Company, Bath, Me., is building four large schooners and two small schooners.

The Scotia Shipbuilding Company, North Yarmouth, N. S., is building a new schooner.

John Young, Honolulu, T. H., is negotiating for the purchase of a powerful tugboat to be equipped with fire-fighting apparatus and used as a patrol boat. It will cost about $100,000.

The Greenport Ship Company, Greenport, L. I., is building a 145-foot steam steel trawler.

PROPOSED CONSTRUCTION

Coaling Tower, Halifax, N. S.—A coaling tower located at Halifax, N. S., was recently badly damaged. Replacement or repair of the tower will cost $20,000.

Concrete Water Barge, San Francisco, Cal.—Harvey & Roberts, San Francisco, Cal., are planning to build a concrete water barge. The plans call for a vessel 65 feet long, 22 feet wide and 9 feet deep, as designed by D. W. & R. Z. Dickie.

Docking Facilities, Vancouver, Wash.—The Port of Vancouver Commission, Vancouver, Wash., has $25,000 now available to build import and export docking facilities. W. Schwartz is city engineer.

Dredging, Shrewsbury River, Shoal Harbor and Compton Creek, N. J.—The United States Engineer Office, 39 Whitehall street, New York City, will solicit bids until July 2 for the dredging of the Shrewsbury River and Shoal Harbor and Compton Creek, N. J.

Dredging, Baltimore, Md.—The United States Engineer Office, Custom House, Baltimore, Md., is ready to contract for the dredging of Curtis Bay Channel. The work will cost about $250,000.

Drydock, Boston, Mass.—S. W. Wakeman, general manager of the Fore River Shipyards, Quincy, Mass., announces that Boston will have a new drydock to cost $5,000,000, which will be constructed by November 15. The port can hereafter be used for repairs.

Drydock, Pensacola, Fla.—The Emergency Fleet Corporation has advanced the city of Pensacola, Fla., $500,000 for the erection of a 5,000-ton drydock. This dock will be built and operated by the Bruce Dry Dock Company, which will spend in addition $200,000 for repair shops, etc.

Drydock, Charleston, S. C.—The Navy Department has announced that the bids received for the construction of the 1,000-foot drydock in Charleston, S. C., were not satisfactory, as all figures were estimated on the cost plus basis plan, which was contrary to the conditions laid down by the Bureau of Yards and Docks. The project will probably be readvertised in the near future.

Earthwork Construction, Muscatine-Louisa Island Levee District, Ia.—Bids were opened on June 19 by the secretary of the Mississippi River Commission, 1311 International Life building, St. Louis, Mo., for earthwork construction by hydraulic method in the Muscatine-Louisa Island Levee District, Ia.

Electric Distributing System, Hampton Roads, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to install an electric distributing system at Hampton Roads, Va., to cost about $60,000.

Fruit Wharf, New Orleans, La.—The Dock Board, New Orleans, La., is planning to construct a steam-heated fruit wharf with 1,000 feet frontage to cost $400,000.

Industrial Building, Hampton Roads, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has had plans prepared for an industrial building to cost $325,000 at the navy yard at Hampton Roads, Va.

Levee, Helena, Ark.—The St. Frances Levee District, Bridge Junction, Helena, Ark., plans to construct a levee at a cost of $200,000. H. N. Pharr, chief engineer, Bridge Junction, will receive bids until July 1.

Lightship, Diamond Shoals, Cape Hatteras.—Secretary of Commerce Redfield is urging the appropriation of $450,000 for the construction of a new lightship to be stationed off Diamond Shoals, Cape Hatteras.

Marine Railway, R. I.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has planned to build a marine railway to cost $15,000. Bids are solicited at the local yards.

Municipal Pier, Gulfport, Tex.—The city of Gulfport, Tex., plans to build a pier ot cost about $7,200.

Oil Distributing Plant, Savannah, Ga.—The Gulf Refining Company, Savannah, Ga., plans to erect a large oil distributing plant to cost about $500,000. Extensive wharfage facilities will also be built. William B. Lamb, Jacksonville, Fla., is the construction superintendent.

Pier, Port Orford, Ore.—A port district was created at a recent election in Curry County, Ore., for the purpose of permitting construction of a suitable loading and discharging pier to handle lumber and incoming freight at Port Orford.

Sand and Gravel Scows, Washington, D. C.—The Columbia Granite & Dredging Company, 3036 K street, Washington, D. C., solicits prices on scows to carry sand and gravel on the Potomac River, capacity 125 to 200 yards.

Piers and Warehouses, Fayetteville, N. C.—The city of Fayetteville, N. C., has engaged Pierce & Alsop, Newport News, Va., to prepare plans for building piers and warehouses on the Cape Fear River. About $75,000 will be spent in the project.

Pilot Boat, San Francisco, Cal.—The Bar Pilots Association, San Francisco, Cal., Capt. John Wallace, secretary, has prepared plans for a new pilot boat, which will be submitted to the builders for bids as soon as the expected increase in shipping in the port materializes. The vessel will be 110 feet long along the waterline and have a beam of 28 feet.

Plant Improvements, Fort Pierce, Fla.—Backus & Son are planning to enlarge and improve their plant, adding facilities to enable them to consider motor boats for the Government.

Port Developments, Tacoma, Wash.—Bonds to the amount of $2,500,000 were voted at a recent election in Tacoma, Wash. Plans have been drawn by Frank J. Walsh, port engineer.

Port Improvements, Gray's Harbor, Wash.—It is reported by A. C. McNeil, Port Commissioner of Montesano, Wash., that the Government will spend $10,000 for improvements at Gray's Harbor, and such further sum as may be necessary in order to deepen the channel of the inner harbor, the main shoal of which is opposite Gray's Harbor City.

Power House, Montauk, N. Y.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., may be addressed concerning a power house at Montauk, N. Y., to cost about $4,000.

Power House and Fire Protection System, Key West, Fla.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the building of a power house and fire protection system at Key West, Fla., to cost about $20,000.

Power Plant, Indianhead, Md.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking for bids for the construction of a power plant at Indianhead, Md., to cost about $200,000.

Power Plant, Algiers, La.—About $539,000 has been appropriated for the construction and enlargement of buildings at the navy yard in Algiers, La. A central power plant is to be installed at an estimated cost of $280,000 and the coaling wharf extended, which will entail an expenditure of $100,000.

River Snag Boat, San Francisco, Cal.—The California Debris Commission, San Francisco, Cal., has opened bids for the construction of a river snag boat. Schultz & Schultz, who offered to construct the vessel for $25,644, were the lowest bidders.

Shipbuilding Plant and Floating Drydock, Lake Union, Wash.—Capt. Mark Pedersen, Sr., has completed arrangements for the leasing of two large areas of shore lands on Lake Union, Latona district, Washington, as a site for a ship construction plant and floating drydock. The company will be incorporated for $50,000 on July 1, and will be known as the University Dry Dock & Construction Company.

Ship Construction and Repair Plant, Norfolk, Va.—The Norfolk-Hampton Roads Dry Dock & Ship Repair Company, Norfolk, Va., is planning the erection of a plant for repairing and constructing steel and wooden vessels.

Steam Schooner, St. Helens, Ore.—The Charles R. McCormick Company, which operates the St. Helens Shipbuilding Company's yard, St. Helens, Ore., is planning to build a steam schooner.

Steel Barge, Port Arthur, Tex.—The Gulf Refining Company, Port Arthur, Tex., G. N. Bliss, marine superintendent, is planning the construction of a steel barge for bunkering purposes to be used in connection with the $500,000 distribution plant to be erected on Hutchinson Island, Savannah, Ga.

Steel Mill, New Orleans, La.—A plan is under way to establish a $100,000 steel rolling mill at New Orleans, La. New Orleans offers an excellent local market for steel products in the shipyards. Bolts, rivets and nuts, as well as other small parts, could be turned out at first, and later it might be found profitable to turn out ship plates.

Steel Tugs, New York.—W. J. Rountree, 23 Beaver street, New York City, is in the market for two 100-foot steel tugs.

Terminal, Boston, Mass.—The United States Shipping Board Emergency Fleet Corporation is considering the construction of a large terminal project near the Charleston Navy Yard, Boston, Mass. Details regarding this development will be given out later.

Terminal, Robbins' Reef, N. Y.—The Lord Construction Company, New York, has proposed to the New Jersey State Board of Commerce and Navigation the construction of a huge terminal on Robbins' Reef in New York harbor. The work would be carried on by a new concern known as the Jersey Dock & Terminal Company, and would include the building of two huge railway trestles connecting the island to the mainland. The island itself would be equipped with piers and warehouses of the latest design.

Terminal, Rahway River, N. J.—H. McL. Harding, terminal engineer, New York City, has been retained to prepare plans for a large terminal of about 5,900 feet frontage and 900 feet in depth, on the north bank of the Rahway River, which empties into Staten Island Sound. A concrete cold storage warehouse, fish shed and pontoon are also included in the plans. The estimated cost of construction is $2,400,000.

Terminal, Arthur Kill, Staten Island Sound, N. J.—H. McL. Harding, terminal engineer, New York City, is now preparing plans for the development of four terminal units, each 600 feet in frontage and about 1,300 feet in width along a 2,400-foot berthing frontage on the Arthur Kill, Staten Island Sound, N. J. Each unit will have modern facilities—a concrete quay wall, paved surfaces, railway tracks for dock coordination between water and railway, traveling gantry jib cranes, drayways, motor trucks and other mechanical equipment. The estimated cost of the facilities and equipment is about $1,200,000. Actual construction will not be started within three months.

Terminals, Halifax, N. S.—It is reported that the Canadian Government will spend several million dollars to improve harbor facilities at Halifax. Plans for new ocean terminals will provide berthing accommodations for 27 large liners, which will occupy a mile and a half of the waterfront at the southern end of the city.

Terminal Development, Berkeley, Cal.—A vast project for terminal development at Berkeley, Cal., was recently made public. Reports state that the improvements include the building of a huge pier, 3,000 feet wide and extending 18,000 feet into the bay from the present high water mark. Deep water channels will be dredged on each side of the pier. Strict secrecy is maintained as to the identity of the interests behind this project.

Waterfront Improvements, St. Paul, Minn.—The city of St. Paul, Minn., is planning improvements to the waterfront on both sides of the Mississippi River. A. Claussen is city engineer.

Wharf, Harbor Island.—The General Petroleum Corporation, Seattle, Wash., plans to build a 600-foot wharf on Harbor Island. W. A. Dudley, district manager, has charge of this work.

Wharf, Newport Beach, Cal.—P. Kressley, engineer, Newport Beach, Cal., is preparing plans for the construction of a wharf 60 by 200 feet at that port.

Wharves and Docks, Pensacola, Fla.—The United Fruit Company, Pensacola, Fla., is planning to construct wharves and docks for handling vessels. Government appropriation has already been received for a wharf and deepening of the harbor.

CONTRACTS LET FOR HARBOR IMPROVEMENTS

Dredging, Hog Island, Boston, Mass.—The Bay State Dredging & Development Company, 62 Condor street, Boston, Mass., has received a contract for dredging the channel and turning basin near Hog Island, Boston harbor.

EQUIPMENT

Boilers, Providence, R. I.—It has been announced that the Field's Point plant of the Bethlehem Shipbuilding Corporation expects to receive large contracts for boilers.

Buoys, Long Island City, N. Y.—The Le Cour Iron Works, Inc., Long Island City, N. Y., has received a contract for furnishing one "L" buoy at a cost of $1,288.

Buoys, Lebanon, Pa.—The Lebanon Boiler Works, Lebanon, Pa., has received a contract to furnish seven "L" type buoys to the Third Lighthouse District to cost $10,346.

Chain Cables.—The Lighthouse Superintendent, 341 Postoffice building, Detroit, Mich., opened bids on June 12 for furnishing 90 fathoms of 1⅜-inch stud link chain cables for light vessel use.

Electric Capstans, Albany, N. Y.—Superintendent of Public Works L. Nixon, Albany, N. Y., opened bids on June 3 for the installation of ten electric capstans and two electric trolley hoists at barge canal terminals. About $14,000 and $1,000, respectively, will be spent for this work.

Electric Traveling Cranes, Transfer Bridges, Electric Freight Elevator, Hampton Roads, Va.—The Navy Department, Bureau of Yards and Docks Washington, D. C., may be addressed concerning the installation of two electric traveling cranes, the building of two transfer bridges and the building of an electric freight elevator at Hampton Roads, Va.

Machinery, Mobile, Ala.—The Marine Equipment Company, Mobile, Ala., is in the market for machinery to manufacture anchors, winches and other ship supplies. Rolf Seeberg is president of the company.

Marine Engines, Miami, Fla.—The Miami Anglers' Boat Company, Hotel Urmey building, Miami, Fla., is in the market for twelve marine engines capable of driving 32-foot boats, 30-inch draft, 9-foot beam, at 12 miles per hour.

Motors, Baltimore, Md.—The Union Shipbuilding Company, Fairfield, Baltimore, Md., is planning to install several motors aggregating 220 horsepower.

Plate Working Machinery, Violet, La.—The National Shipbuilding Company, with yards at Three Rivers, Quebec, and Violet, La., has purchased second-hand plate-working machinery for installation at the Violet yard.

Propellers, Astoria, Ore.—The Astoria Marine Iron Works, Astoria, Ore., has received a contract to supply 60 propellers for foreign account.

Traveling Cranes, Mare Island, Cal.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is soliciting bids for the erection of three traveling cranes in the Mare Island, Cal., structural shop to cost about $250,000.

Salvage Equipment, Spain.—It is reported by Vice-Consul W. Bruce Wallace, Corunna, Spain, that an important salvage company has been organized by Spanish capitalists, and although the company is well equipped, new purchases are constantly being made of the lastest devices pertaining to deep-sea salvage operations, also machinery for the reduction of salvage materials.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Coppersmith, Tinsmith and Pipe Shops, Alexandria, Va.—The Virginia Shipbuilding Corporation, Alexandria, Va., has started to rebuild their coppersmith, tinsmith and pipe shops, recently destroyed by fire. The copper and tinsmith shops are being completely refitted with new tools and machinery for building all sizes of copper piping, bends, expansion bends, copper expansion joints, sheet metal cowls, tanks, ventilators, steam tables, etc.

Drydock, San Pedro, Cal.—The Southwestern Dry Dock Company, San Pedro, Cal., has been capitalized at $1,000,000 to build a drydock.

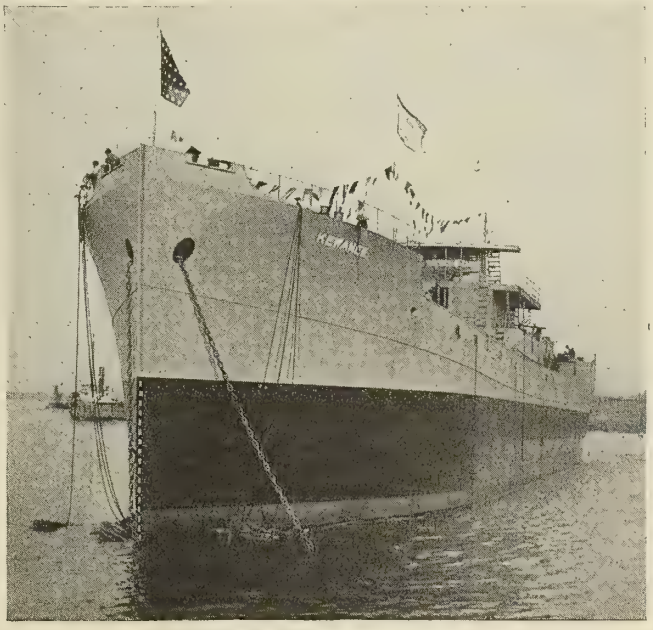
Drydock, Kingston, Jamaica.—The Jamaica West Indies Government is considering a plan for harbor improvement. It is proposed to construct a drydock and an up-to-date coaling station

Drydock, Seattle, Wash.—Construction has been begun on the first two pontoons of an 18,000-ton drydock which the Ames Shipbuilding & Dry Dock Company, Seattle, Wash., is constructing. The drydock will have a total length of 540 feet, which will accommodate a ship 650 feet long. The work is being carried out under the supervision of C. J. Carlson, owner of the Carlson yard in Port Blakeley. The pontoons will be fitted with 50-foot towers and electric-driven pumping apparatus will be installed.

Drydock, Brooklyn, N. Y.—An appropriation of $6,000,000 is being arranged by the Navy Department, Washington, D. C., for the reconstruction and improvement of drydock No. 3, navy yard, Brooklyn, N. Y., to include construction and repair facilities for ship work.

Foundry and Machine Shop, Vancouver, B. C.—The Mainland Engineering Company, 442 Railway street, Vancouver, B. C., has received bids through its architects, Gardiner & Mercer, 827 Burkes building, Vancouver, B. C., for the erection of a pattern shop, foundry and machine shop at the plant.

General Repair and Machine Shop, East Boston, Mass.—The Simpson Dry Dock Company, East Boston, Mass., is building a new plate shop 100 by 30 feet, and a machine shop 100 by 60 feet, to provide facilities for general repairing. Both plants will be run by electric power.



Launching the *Kewanee*

Moore Plant of Bethlehem Shipbuilding Corporation Shows Good Record

Since November 20, 1918, the Moore plant of the Bethlehem Shipbuilding Corporation, Elizabeth, N. J., has launched fourteen ocean-going tugs and delivered ten. In addition this shipyard has launched the 5,000-ton tanker *Kewanee*.

Machine Shop, Mariner's Harbor, S. I.—The Brewer Dry Dock Company, Richmond Terrace, Mariner's Harbor, S. I., has awarded a contract to John Milnes Company, Port Richmond, S. I., for the building of a $16,000 machine shop.

Marine Repairs, New York.—A. J. Wolcott & Company, New York, has been incorporated, with a capital stock of $10,000, to carry on a marine repair and contracting business. J. Groenewald, L. R. Swift and A. J. Wolcott, 439 Eightieth street, Brooklyn, N. Y., are the incorporators.

Plate Mill and Machine Shop, Halifax, N. S.—The Halifax Shipyards, Ltd., Halifax, N. S., has let a contract to the Bedford Construction Company, Barrington, street, for the erection of a plate mill to cost about $300,000, and also a machine shop.

Pontoons, Rockaway Beach, L. I.—

The Arverne Shipyards, Inc., Rockaway Beach, L. I., has received a Government contract to build several pontoons for drydocks.

Repair Plant, Eagle Harbor, Wash.—James Griffiths & Sons, Eagle Harbor, Wash., have again taken over the general ship repair plant which has recently been operated by the Winslow Marine Railway & Shipbuilding Company, and will operate the plant for general repair work.

Repair Plant, Norfolk, Va.—Work will soon be started on the $6,000,000 ship repair plant of the Hampton Roads Dry Dock & Ship Repair Corporation at Lambert's Point, near Norfolk, Va. It is reported that James Stewart & Company, Inc., 30 Church street, New York, will receive the contract. The construction plans include one 4,000-foot bulkhead, three piers, 900 feet long by 75 feet wide, one drydock to accommodate 10,000-ton vessels, one drydock to accommodate 15,000-ton vessels, twelve buildings, including administration offices, machine shops and foundries.

Ship Repair Plant, Oswego, N. Y.—The Hinckley Towing Company, Oswego, N. Y., is planning to erect a new ship repair works. The plant is estimated to cost about $100,000, and will include machine tools and machinery for ship repairs and construction, drydock, marine railway, cranes, hoisting machinery, etc.

Shipyard, Kingston, N. Y.—The capital of the W. F. & R. Boat Builders, Inc., Kingston, N. Y., has been increased from $10,000 to $60,000.

Shipyard, Newcastle, N. B.—It is reported that the International Shipbuilding Company's yard at Newcastle, N. B., has been sold to the Miramishi Construction Company.

Shipyard, Chattanooga, Tenn.—The Tennessee River Navigation Company, Chattanooga, Tenn., is planning to lease a five-way shipyard to be erected by a local corporation at Chattanooga, Tenn., to be used for building and repairing river steamers.

Shipyard Improvements, Sparrow's Point, Md.—The Bethlehem Steel Corporation, Bethlehem, Pa., will spend between $25,000,000 and $40,000,000 in improvements at the Sparrow's Point plant. This will be in addition to the $50,000,000 improvements now being completed. Ten ships will be added to the present ore fleet of the corporation.

T. A. Scott Succeeds Bainbridge Colby on the Shipping Board

Thomas A. Scott, of New London, has been appointed a commissioner of the United States Shipping Board to succeed Bainbridge Colby, who resigned several weeks ago.

Mr. Scott is president of the P. A. Scott Towing, Pile Driving & Wharf Building Company, and F. Scott Investment Company, both of New London. He is now a lieutenant commander in the United States Naval Reserve force.

PERSONALS

Capt. Elworth P. Bertholf has resigned from the Coast Guard Service to become vice-president of the American Bureau of Shipping.

John E. Barber, who has acted as Chairman Edward N. Hurley's assistant in studying shipping conditions abroad, has been appointed vice-president of the Emergency Fleet Corporation in charge of sales, with offices at 135 Broadway, New York City.

F. G. Echols, for many years general manager of the small tools department of Pratt & Whitney Company, Hartford, Conn., has accepted a position as vice-president of the Greenfield Tap & Die Corporation, Greenfield, Mass.

W. R. Robinson, who for the last five years has been Seattle manager for W. R. Grace & Company, has severed his connection with that firm to become Eastern representative of the Northwestern Trading Company, with offices in New York City.

M. J. Scammell has resigned as assistant general manager of the Sparrow's Point plant of the Bethlehem Steel Corporation, with which he has been connected since 1912.

Miss Ruth Edwards, for twelve years treasurer of the Bantam Ball Bearing Company, Bantam, Conn., has resigned.

William W. Cropley, who received his shipbuilding training at Denny's, Dumbarton, Scotland, and who for the past nine years has been connected with the Robins Dry Dock & Repair Company, Brooklyn, N. Y.; the New England Paper Mills Company and the Tietjen & Lang Dry Dock & Repair Company, Hoboken, N. J., has been made assistant superintendent of the Ramberg Dry Dock & Repair Company, Brooklyn, N. Y.

Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been elected a member of the Council of the National Merchant Marine Association.

E. A. Hitchcock, formerly connected with the E. W. Clark & Company Management Corporation as advisory, consulting and power sales engineer, has recently became connected with the Bailey Meter Company, Cleveland, Ohio, as vice-president, to supervise the training of technical graduates for the company's service and sales departments.

Calvert Townley, assistant to the president of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been elected president of the American Institute of Electrical Engineers.

L. A. Block, who has served as resident inspector of marine propulsion units at the De Laval Steam Turbine Company, Trenton, N. J., for the Shipping Board Emergency Fleet Corporation, has been transferred to the Fore River plant of the Bethlehem Shipbuilding Corporation, Quincy, Mass., to assume a similar position. He is succeeded by J. K. Etter, formerly inspector of turbines at the Westinghouse plant, Chester, Pa.

Ray B. Whitman, a Chicago naval architect, who has recently been connected with the Emergency Fleet Corporation at Cleveland, Ohio, has opened offices at 505 Fifth avenue, New York City, to practice as patent attorney and engineer.

RECENT LAUNCHINGS

The Albina Engine & Machine Works, Inc., Portland, Ore., launched the 3,800-ton steel steamer *Meriden* on May 22.

The American International Shipbuilding Corporation, Hog Island, Pa., launched its twenty-seventh ship, the *Shaume*, on May 10; its twenty-eighth ship, the *Ogontz*, on May 20; the 7,500-ton ship, *Salvation Lass*, on May 24; five cargo vessels, each 7,800 tons, namely, the *Lehigh*, *Maiden Creek*, *Nedmac*, *Shavano* and *Pipestone County*, on May 30, and the thirty-fifth ship, the *Fluor Spar*, on June 7.

The Ames Shipbuilding & Dry Dock Company, Seattle, Wash., launched the 8,800-ton steel steamship *West Isleta* on May 15.

Barbare Bros., Tacoma, Wash., launched the Ferris type vessel *Imumka* on May 30. This is the last wooden vessel under construction at that yard for the United States Shipping Board.

The Bayles Shipyard, Inc., Port Jefferson, L. I., launched a 5,000-ton steamer and an ocean-going tug, the *Bastrop*, on May 31, building for the United States Shipping Board.

The Beaumont Ship Building & Dry Dock Company, Beaumont, Tex., recently launched the Ferris type vessel *Angelina*.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has recently launched the following ships: (Squantum) the destroyer *Swasey*, on May 7; (Fore River) the destroyer *Welles*, on May 8; (Alameda) the oil tanker *De Volente*, on May 13; (Potrero) the destroyer *Stansbury*, on May 16; (Union) the destroyer *No.* 108, on May 16; (Quincy) the destroyer *Meade* and the submarines *R*-9 and *AA*-3, on May 24; (Union) the submarines *Wood* and *Zeilin*, on May 28; (Squantum, the torpedo-boat destroyer *Sinclair*, on June 2.

OBITUARY

Paul M. Einert, special representative to the chairman of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., with offices in New York, died suddenly on June 5 at his home in New York City, aged 56 years.

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America Leads In Shipbuilding

VESSELS built in the United States and officially numbered by the Bureau of Navigation, Department of Commerce, during the fiscal year ended June 30, 1919, totaled 2,182 of 3,739,372 gross tons. In addition to this, 59 vessels of 121,112 gross tons were built for foreign owners, making the total output from American yards for the year 2,241 vessels of 3,860,484 gross tons. This amounts to two-thirds of the world's output for the year and is nearly 16 percent greater than the total world's output in 1913, the year in which the largest tonnage of vessels was produced in the world before the war.

With this record-breaking output, the American merchant marine on June 30, 1919, had grown to approximately 27,300 vessels of 12,800,000 gross tons. To this total there should be added 56 ocean steamships of 405,000 gross tons which are temporarily employed as transports and troop ships by the Army and Navy. During the past three months—that is, April, May and June—the American merchant fleet was increased by slightly over 1,000,000 gross tons. At the present time half of the American merchant tonnage is registered for foreign trade—a situation without parallel since 1856. For purposes of foreign trade, attention may be confined, generally speaking, to sea-going vessels of 1,000 gross tons or over, of which on June 30, 1919, our merchant fleet included 2,058 of 7,300,022 gross tons out of the total of 12,800,000 gross tons (not including 405,000 gross tons in military service). How enormous this growth has been is shown by the fact that on July 30, 1914, just before the war, the American fleet of sea-going vessels of 1,000 gross tons or over numbered 755 of 2,128,731 gross tons out of the total fleet of 7,928,688 gross tons.

The tonnage of sailing vessels during this time has increased inappreciably—less than 2 percent. The tonnage of wooden sea-going steamships of 1,000 gross tons, however, has increased from 8 vessels of 10,595 gross tons on June 30, 1914, to 293 vessels of 693,541 gross tons on June 30, 1919.

The transfer of ships from foreign flags to the American flag virtually ceased during the past fiscal year, the only additions from foreign countries being almost exclusively Japanese tonnage bought by the United States Shipping Board. The transfer of ships from the American to foreign flags during the same time amounted to only 38,200 gross tons. Ships lost and abandoned during the first nine months of the fiscal year aggregated 267,485 gross tons, and for the whole year will only slightly exceed 300,000 gross tons.

This record output from American shipyards places the United States, for the second time in over half a century, in the first place in the world's output of shipping.

1,000-Foot Ships to Be Built

FOLLOWING closely upon the heels of the record-breaking output of American shipyards during the past fiscal year comes the announcement of the Shipping Board of its intention to build two 1,000-foot, 30-knot passenger liners of 55,000 gross tons each for transatlantic service. These vessels, it is stated, will have a beam of 102 feet, a depth of 74 feet and a draft of 35 feet. Provided with propelling machinery capable of developing 110,000 horsepower on four shafts and a cruising radius of 7,000 miles, these new ocean greyhounds will cut down the passage to England to four days. Accommodations will be provided for 1,000 first class, 800 second class and 1,200 steerage passengers, besides a crew of 1,000 officers and men. These vessels will be built with a view to immediate conversion into naval auxiliaries in the event of war, and in this connection Chairman Hurley of the Shipping Board has recommended in a letter to the Secretary of the Navy that the ships be constructed under the supervision of a committee composed of Rear Admiral D. W. Taylor, U. S. N., chief of the Bureau of Construction and Repair, chairman; Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company; Joseph W. Powell, vice-president of the Bethlehem Shipbuilding Corporation, Ltd.; N. A. Neeland, president of the New York Shipbuilding Corporation; H. G. Mull, president of the William Cramp & Sons Ship & Engine Building Company, and W. F. Gibbs, naval architect of the International Mercantile Marine Company.

While this project is still in the preparatory stage of development and definite action as to the placing of contracts for the construction of the vessels has not yet been taken by the Shipping Board, nevertheless, according to statements made by Mr. Hurley before relinquishing his post as chairman of the Shipping Board, the adoption of the plan is certain and in all probability the construction of the first two vessels will be followed by the construction of two other similar ships, making a fleet of four giant transatlantic flyers, American built, American manned and American classed, representing the last word in safety, speed and luxury in ocean liner construction. That the Shipping Board is in a position to build these vessels without financial or other authorization from Congress is found in the fact that in passing the last appropriation for shipbuilding Congress specifically provided that the Shipping Board might dispose of its smaller ships and use the funds thus realized to build larger vessels in order to balance the merchant marine fleet. The Shipping Board already has at its disposal several of the large German passenger liners, seized during the war, but more passenger vessels are needed, and the proposal to build

this fleet of super-leviathans is fully in keeping with the determination of the United States to forge its way into a leading position in the shipping world. Recent figures show that the Shipping Board now has 829 vessels of 4,248,973 deadweight tons engaged in the general commerce of the seas, exclusive of more than 2,500,000 tons still in military service and in overseas civilian food relief work. Sixty-two regular cargo lines are now in operation by the Shipping Board on trade routes which have been opened in the last six months as one of the first steps in the conversion of ocean-going tonnage released from war work to commercial service. With regular American cargo steamship lines now in operation from the United States to every quarter of the globe and with new lines to be established as fast as new tonnage becomes available there is every reason for the United States to build vessels of a type specially suited to meet competition in the direct transatlantic passenger traffic. The plan of the Shipping Board to build the 1,000-foot ships is well conceived and should be put into action with all possible speed.

Revision of the Navigation Laws

OVER three months ago in an address on the relation of law to the development of our merchant marine, delivered at the sixth National Foreign Trade Convention, a New York lawyer asked the following pertinent question:

"Is there a person present who needs to be told that, due to the high costs of construction, operation and maintenance, caused by tariffs and restrictive measures that practically limit American registry to American-built ships; that require a more extensive menu for seamen; that limit the operation to citizen officers and to crews three-fourths of whom must be able to understand English; that require a wage scale in excess of any obtaining in the wide world; that sanction contracts which, so far as the seamen are concerned, are mere scraps of paper which can be breached by the men practically at will and without penalties; that prohibit owners from forming pools or combinations to stabilize rates, apportion and give definiteness to sailings and prevent destructive competition, unless sanctioned by the whims of a board politically organized; that limit insurance to corporations or associations which are required, in most states in which they do business, to deposit a large percentage of their capital for indemnity purposes; that require more officers and men to man ships than practice and experience requires or justifies; so long as such laws and restrictions remain or are not modified, or in lieu thereof some plan devised to counterbalance their defects, such causes must of necessity preclude the successful maintenance of a merchant marine?"

While the above statement may not accurately represent conditions as they exist, there is no doubt that certain provisions of the navigation laws impose a serious handicap upon American ship owners and make it impossible to operate American ships as economically as vessels under foreign flags. If the American merchant marine is to be built up, or successfully maintained, it must be in a position to meet foreign competition on equal terms and not forced to bear unnecessary burdens due to defective and impractical laws. In discussing this matter at the recent shipping conference at Washington the president of the International Mercantile Marine stated that, as far as the laws are concerned, they need certain modifications in order to put an American ship at as little disadvantage as possible the world over.

Some time ago it was understood that the Shipping Board had appointed a committee of prominent shipping men to formulate recommendations for the revision of the navigation laws and it was to be expected that by this time substantial progress would have been made in this direction, but in a recent press despatch it was stated that the members of this committee had not yet been notified of their appointment! Isn't it about time that this vital matter should be thoroughly investigated?

Employment Managers in the Shipyards

THE annual meeting of the Employment Managers' Committee of the Atlantic Coast Shipbuilders' Association, recently held in Atlantic City, was a notable gathering both in attendance and in the importance of the subjects discussed. Until the shipbuilders were confronted with the enormous war shipbuilding programme and the staggering problems involved in the recruiting of labor for this gigantic task there had been little co-operation among the employment departments of the various yards, and each yard was handling its labor problems in its own way, and, in many cases, due to the lack of co-operation, rather inefficiently. But early in 1918 labor was at a premium or practically unavailable. Men were being enticed from one industry to another, and frequently from one shipyard to another with disastrous results. This condition immediately developed the need for co-operation and a better understanding among the shipyard employment department heads, with the result that the Employment Managers' Committee of the Atlantic Coast Shipbuilders' Association was organized as a distinct body with its own officers. The active membership includes thirty-six employment department heads, who were responsible during the latter period of the war emergency for the maintenance of working forces totalling more than 200,000 employes in the shipyards holding membership in the Atlantic Coast Shipbuilders' Association. Associate members are the service managers of the same yards and the employment managers of wooden, concrete, repair and other yards not eligible to membership in the association.

According to the annual report of the secretary, important strides were made in eliminating extravagant and demoralizing scamping among the shipyards, thereby exerting a strong influence in stabilizing the labor supply in the shipyards without removing the wholesome elements of clean-cut competition. A standardized plan of draft procedure was adopted for dealing with employees and ridding the yards of slackers. Other uniform methods were employed to meet the various annoying problems that threatened to impede the shipbuilding programme.

A standard practice of figuring labor turnover and handling employment statistics was adopted, and in one instance several yards formulated a plan for the collective recruiting of labor which brought about satisfactory results. The committee also took an active part in the cataloguing of discharged soldiers at the thirty demobilization camps throughout the country, furnishing information to the employment departments regarding more than 6,000 discharged soldiers who were seeking shipyard work.

It is planned to establish through the association's Philadelphia office a clearing house on information regarding the labor supply whereby any shipyard having a surplus of men in any craft will so notify the secretary and this information will be available for the other yards. An exchange of weeky reports is embodied in the plan.

Plans for English Channel Train Ferries

LONG before the end of the war, plans had been completed for the installation of an English Channel ferry for the transport of freight and passenger cars between England and France. The interest centered in this project was largely due to the efforts of Michel Mercurio, the Paris banker and organizer of the Societé Française d'Action Economique, under whose leadership there was formed the Societé Centrale des Ferry Boats. As a first step, this company bought the Inter-Continental Railway Company, Ltd., which had perfected rights for the installation of train ferries between Newhaven and Dieppe. Even before the war this project had gained the support of Messrs. Schneider & Company in France and Lord Weardale in England, as well as of Paul Bignon, deputy of Dieppe and president of the Conseil Generale of the Seine Inferieure. Monsieur Bignon is at present president of the Societe des Ferry Boats.

According to Daniel T. Pierce, New York, American representative of the Française d'Action Economique, an intensive study has been made of the opportunities for developing train ferries, both from the engineering and commercial points of view, the Societé Centrale bringing together a consulting council which includes two engineers of the Ministry of Public Works; Luigi Luiggi, of the International Commission of the Suez Canal; representatives of the Chambers of Commerce of London and Paris; Paul Cloarec, vice-president of the Ligue Maritime Française; John Kenneth Foster, of the Great Eastern Railway, London, and others whose engineering, transportation and commercial co-operation has brought together all possible information and wisdom on the problem to be solved.

In the investigation undertaken under the guidance of the Societé Centrale, all past and present train ferries have been thoroughly investigated. The record of these begins in 1852 with the transport of trains on boats across the Firth of Forth and the Firth of Tay. These ferries were in successful operation up to the construction of the famous bridges over these bodies of water. An extensive train traffic is also handled between Denmark and Sweden, one of these lines inaugurated in 1903 being 26 miles in length. The report states that the excellence of this service has been demonstrated over a long period and that the "journey between Copenhagen and Sweden takes place, even for sleeping car passengers, without notice to them that the sea has been crossed." Account is also, of course, taken of the train ferry between Key West and Havana, and the transport of trains on Lake Michigan and Lake Erie, and of the lines between Reggio, Calabra and Messina, Sicily. Of the latter it is said that they "permit the constant passage of train ferries between the Continent and Sicily even in the worst weather." Special stress is laid on the success of the ferry between Sassenitz, Germany, and Trelleborg, Sweden, established in 1909, which covers a distance about equal to that which separates Dieppe from Newhaven.

Some very interesting figures are given as to the increase of traffic brought about by this latter train ferry. In the six-months' period prior to the starting of the ferry, 9,640 passengers and 2,600 tons of merchandise passed between the two points named. In a similar period two years later (July-December, 1911) the Sassenitz-Trelleborg ferry was handling 48,600 passengers and 42,000 tons of freight.

Beginning with the Newhaven-Dieppe ferry, the Societé Centrale has now organized two other undertakings, one of which is known as the North of France and Orient ferry, which has the full co-operation of the International Sleeping Car Company and the approval of the French Government, which has already assured a subsidy for the carrying of mails by this route. By this means trains will be operated without change from England to Brindisi and Constantinople.

A third train ferry project, also mothered by the Societé Centrale, will run between Harwich and Ostend. This latter project has already gained the co-operation of the Great Eastern Railway. In Belgium the Harwich-Ostend ferry is actively supported by Monsieur Paul Siegers, late Minister of Marine, and at present holding another portfolio in the Belgian Government.

All of these undertakings have emerged from the status of mere projects and are going forward to completion far in advance of the more spectacular plans for a channel tunnel, although the next generation will undoubtedly see a tunnel completed between England and France, as all objections to this plan have disappeared as a result of the war.

The specifications on which tenders have been asked from English shipbuilders call for boats of 21 knots speed, the "utilizable" length of rails on the vessels to be 689 feet. This trackage would accommodate 22 freight cars of 20 tons each, or 10 freight cars and a train comprising 7 passenger cars 49 feet 3 inches in length and one luggage van. The draft of the boats is not to exceed 15 feet 9 inches.

In commenting upon the train ferry plans of the Societé Centrale, Monsieur Mercurio justifies them first of all on the ground that "our economic prosperity absolutely depends upon better transportation. It is therefore a patriotic duty to go to work at once and without delay in order to assure revictualling, to reconstitute stocks, to intensify commercial relations—in a word, to realize a policy of extensive, cheap and rapid transportation, useful and profitable both to general and individual interests."

LETTERS TO THE EDITOR

What is the Matter with the Society of Naval Architects and Marine Engineers?

The letter in your issue of July regarding the Society of Naval Architects and Marine Engineers is a very timely one.

There was an informal meeting called in Washington the middle of January by Senator Ransdell and others to discuss the question of organizing what has become the National Merchant Marine Association. So far as I know, no one attended this meeting who in any way whatever represented the society, and in the two-days' talk at the meeting no reference was made to the society.

Late in March another meeting was called to make the temporary organization permanent. At this meeting there was no reference made to the Society of Naval Architects and Marine Engineers, nor was there anybody present who apparently represented the society in any way.

Late in May, Mr. Hurley, chairman of the Shipping Board, called leading men together to discuss merchant marine matters, and, so far as I can learn, no one present represented the Society of Naval Architects and Marine Engineers.

I agree with your correspondent that the society ought to be active in important movements looking toward the upbuilding of the American merchant marine.

Another Member.

Electric Drive on Merchant Ships

Will the sweeping statements made by Mr. W. L. R. Emmet in his comparison of electric drive with reduction gearing for merchant ships in your May issue stand examination in the light of all the facts? Some of the facts may be unknown to Mr. Emmet, but that does not render his conclusions any more valid.

He contends, first, that electric drive is practically as efficient as gear drive, and, second, that it is more simple and reliable.

He claims for the electric drive with high-speed turbines and the most improved electrical apparatus a transmission efficiency of 93.5 percent, but says that the efficiency of a smoothly running double-reduction gear equipment in good condition does not exceed 94.5 percent.

Careful tests made by different manufacturers, however, show conclusively that the efficiency of a helical gear reduction, designed on correct principles and with good workmanship, is, if anything, higher than 98.5 percent, and the efficiency of a double-reduction gear should, therefore, be about 97 percent. These figures are corroborated by tests made on a 2,500-horsepower De Laval marine turbine with double gear reduction in actual service. When developing full load, the rise in temperature of the oil passing through the machine did not exceed 10 degrees F. when circulating 75 gallons of oil per minute. The temperatures of gear cases, covers and bearing caps were only a little above the engine room temperature, so that the loss of heat by radiation can be ignored or can be offset against the heat developed in the two main turbine bearings and in the turbine thrust bearings, since the oil from the latter was not separated from that used on the gears. These figures indicate a gear efficiency of 97.7 percent.

Careful tests made in 1909 on the first Melville-Macalpine gear reduction showed an efficiency of 98.75 percent.

A small double helical gear (about 30 horsepower, running at 1,800 revolutions per minute) tested in 1911 gave an efficiency of over 98 percent, as described in *Zeitschrift des Vereines Deutcher Ingenieure,* August 26, 1911. The method used in testing this small gear is of interest and can be applied to larger gears. Two identical gear reductions were connected together by coupling the two pinions and the two gears, respectively. One of these couplings was a specially designed spring coupling, so that known tooth pressures, corresponding to different loads, could be established. The whole was then driven by a small calibrated motor, and by measuring the electrical input to the latter it was possible to determine the amount of energy consumed by the gearing.

There is no reason why the efficiency of ship gears should be lower than that of gears in land service. The foregoing figures show that with properly designed gears it should not be less than 97 percent, and the advantage of double gearing over the electric drive, using the figures claimed by Mr. Emmet for the latter, would thus be over 3½ percent. The advantage of the single reduction gear would be still greater.

Mr. Emmet is unfavorable to single reduction gears and to the division of the turbine into two or more parts, stating that the latter arrangement has increased packing losses and complication. It has several advantages, however, which more than counterbalance the slight disadvantages, for instance:

1. The division of the turbine into two parts makes it possible to obtain better thermal efficiency through being able to use a greater number of stages without extremely long turbine casings with their accompanying troubles from distortion by temperature. More stages give lower steam velocities, less erosion of buckets and lower bucket velocities.

2. A single-screw vessel equipped with compound turbines is always able to proceed at slightly reduced speed with one turbine in case of an accident to either turbine, whereas a single turbine vessel, whether with gear transmission or with electric transmission, would be at the mercy of the sea.

3. The compound turbine gives equal distribution of load through the gear sets, which is a great advantage in connection with double gear reductions. Some of the gear trouble experienced with double gear reductions in connection with single turbines have undoubtedly been due to difficulties in providing sufficient flexibility in the connection between the high-speed gears and the low-speed pinions, since the load distribution cannot be equal unless the alinement between the teeth is far more perfect than it is practically possible to obtain, even by using so-called flexible gears or a flexible shaft passing through a hollow low-speed pinion.

An important fact, not mentioned by Mr. Emmet, is that whereas some manufacturers of gears have had much trouble, others have had little or none. The troubles in the low-speed elements of marine gears, to which he alludes, are easily explained by the fact that certain gear builders apparently believe that their special designs of gears allow the use of considerably higher tooth pressures than have proved to be practical in the extended experience of other builders.

Mr. Emmet states that the principal troubles with marine gears have developed in the low-speed elements of double reduction gears, due, he suggests, to severe shocks and periodic vibrations from the propeller. It is difficult to understand, however, why the low-speed gear of a double reduction gear should have more trouble from this source than single reduction gears, many of which are in satisfactory operation. Properly designed low-speed reductions are very smooth and practically noiseless in operation, which would not be true if shocks or vibrations from the propeller were sufficient to cause excessive wear or breakage of teeth.

Finally, it appears to me that when all of the features and complicated parts of the electric drive are compared with the simplicity of the gear drive, either of the double reduction or single reduction types, the gears are to be preferred, the more so as they effect considerable economies in power, weight and space. Electric drive involves the use of steam turbines, electric generators, electric motors and complicated controlling mechanism, the care of which requires the services of skilled electricians of long training. The significance of this aspect of the matter cannot be escaped in reading the description of the equipment of the United States battleship *New Mexico,* which appears in the same issue with Mr. Emmet's article. The electric transmission equipment of a four-screw battleship developing some 23,000 kilowatts is naturally more extensive and complicated than that of a one- or two-screw cargo steamer requiring only 3,000 to 8,000 horsepower; but, even if the amount of electrical equipment installed on the *New Mexico* be divided by 10, it will still prove staggering to the ordinary marine engineer, and will certainly offer many more possibilities of derangement and mal-function than do the rugged gears of simple design and construction, which have already proved their reliability in both merchant and war vessels.

Trenton, N. J. A. PETERSON,
Engineer, De Laval Steam Turbine Company.

The United States Shipping Board has announced that it has vacancies for 1,500 firemen in the merchant marine.

Congress Grapples with the Problem of the Establishment of an American Merchant Marine

BY WALDON FAWCETT

HOW to perpetuate and how best to extend and develop the American merchant marine that attained to proud dimensions during the war is one of the most important problems before the 66th Congress of the United States at its first or special session. That not only the significance of the issue, but likewise the need for prompt solution is well recognized in the national legislature, is attested by the fact that the merchant marine question has been placed alongside that of railroad control and regulation of railroad rates for consideration in advance of other features of administrative policy.

It is proverbial that the real work of Congress and the formulation of policies take place in committees, and it is therefore interesting to note what is taking place in the subordinate bodies to which Cngress looks for recommendations as to the legislation that is needed to provide for the future of the merchant marine. In the United States Senate the responsibility for determining the Governmental attitude toward the merchant marine has been entrusted to the Committee on Commerce. In the House of Representatives it is the Committee on the Merchant Marine and Fisheries that is wrestling with the complex problem. These respective committees have inaugurated hearings that will extend over an interval of weeks, and perhaps of months, and embodied in the testimony that is being submitted are not a few points likely to prove of interest to practical men in the shipping and shipbuilding fields.

Foreign Contracts for American Yards

For example, the first question to be raised at these hearings was that of the freedom of American shipbuilders to solicit and accept foreign contracts. Stating his position on this proposition, Chairman Edward N. Hurley, of the Shipping Board, replying to the questions of Senators, said: "I do not think there is any reason why the American shipyards should not have the right to accept bids and negotiate for foreign contracts. We feel that there should be no restrictions on the negotiations between the shipbuilders and foreign buyers, with this exception: We have about $75,000,000 (£15,400,000) worth of shipbuilding materials to salvage, which we are trying to dispose of, and we have felt that we could dispose of that better by co-operating with the American builders. If the American builder closes his contract with a foreign buyer and he has claims against the United States Shipping Board Emergency Fleet Corporation, or whether he has such claims or not, we feel that we should like to have the shipbuilder come in to see us, to ascertain if we can not in a co-operative way dispose of that material, in order to relieve the situation throughout the country, particularly in connection with the manufacturing of boilers, engines and other materials that are now stored in the different warehouses throughout the country. If we do not have, I would not say control, but some method of having a voice in that, I am fearful that we will have a lot of material left on our hands that we might otherwise dispose of through the shipbuilders and the foreign buyers."

It was recognized in the discussion that the interest of a shipbuilder in the engines, boilers, shapes, plates, etc., that the Government is desirous of salvaging is contingent upon his securance, for foreign or domestic account, of contracts for the particular style of ship to which the Government material is adapted. However, a number of Senators who have shipbuilders among their constituents are suspicious that, for all the ostensible lifting by the President of the ban on foreign contracts, undue pressure is yet being brought to bear by the Shipping Board to induce shipbuilders who make private contracts to take over for their operations a share of the Government's "left over" material. There has been considerable cross-examination at the hearings as to the demand of the Shipping Board that it be allowed to *visé* private contracts entered into by shipbuilders with whom it has commitments, and effort has been made to bring out whether the adjustment of the Shipping Board's contracts—a large proportion of which remain to be disposed of—is being delayed for the purpose of bringing pressure to bear upon contractors to take over material that the Government desires to get rid of. At one stage of the examination of Mr. Hurley, the chairman of the Senate Committee asked the head of the Shipping Board: "Is it good policy for the Government to hold up shipbuilding until you can negotiate with the parties to sell to them the salvage which you have on hand?"

Senator Harding raised the question whether it might not be possible in the event that private shipbuilders are not willing to take the salvage off the Government's hands at a reasonable sacrifice to select a Government-controlled shipyard or a yard in which the Government has an equity (other than a fabricating yard) and there mobilize all salvage and utilize it in the construction of ships. Chairman Hurley expressed the opinion that it would be impracticable thus to attempt to use odds and ends in all stages of manufacture that would have to be assembled from shipyards in all parts of the country.

Cost of Shipbuilding Abroad

In answer to inquiries from Senators, Chairman Hurley and other officials of the Shipping Board gave $140 (29/3/4) to $160 (33/6/8) as the present cost of ship construction in Great Britain, with a proviso in each contract that increases in labor costs must be taken care of by the buyer. American shipbuilders who have within the past few weeks bid on foreign contracts were represented as bidding $144 (30/0/0) to $162 (33/15/0) a ton, although Chairman Hurley told of a report, in which he confessedly did not take much stock, of a broker's transaction that contemplated the construction on the Pacific coast of eight steamers of 8,800 tons each at a cost of $135 (28/2/6) a ton.

Under its contracts the Shipping Board has been paying approximately $206 (42/18) per ton, but a special committee of shipbuilders and ship operators appointed some months since to act in an advisory capacity has recommended that contracts for steel steamers of less than 9,000 tons' capacity for completion in 1920 should be can-

celed in all cases where cancellation can be effected at a basis of approximately $75 (15/12/6) per deadweight ton, "as it is doubtful whether such steamers would have a market value when completed of more than $100 (20/16/8) per ton deadweight capacity."

In the consideration in the Senate committee of war-time shipbuilding costs, considerable stress has been laid upon the fact that the cost to the Government is not adequately represented by that ratio of tonnage to monetary outlay which indicates a cost of $206 (42/18/4) a deadweight ton. Set over against this is the fact that some shipbuilders in this country have paid into the United States Treasury income and excess profit taxes aggregating $40 (8/6/8) a deadweight ton on the vessels they have constructed. Others have paid the equivalent of $30 (6/5/0) a ton, and it has been estimated that in no instance has less than $25 (5/4/2) a deadweight ton been returned to the Treasury in war taxes, this virtual rebate to the Government taking no account of the special taxes paid by sub-contractors. On this theory, Chairman Hurley and his associates estimate that $180 (37/10/0) a deadweight ton the actual cost to the Government of its war-inspired merchant fleet.

Value of Cargo Ships

The present-day value and the prospective value of cargo ships have been a subject of animated discussion throughout the hearings thus far held. At one session Commander Ackerson, U. S. N., of the Shipping Board staff, told of the impression among ship operators that ships are not worth more than $150 (31/5/0) per ton to-day. He made it clear, however, that he did not sympathize with so conservative an appraisal. Asserting his optimism, he declared that he believed a ship is worth more than $200 (41/13/4) a ton to-day, "and will be worth more than $250 (52/1/8) six months from to-day."

For all his confidence, however in the value of ships, present and prospective, the Shipping Board executive was dubious as to the wisdom of investing Government money for the completion of ships now under contract but in the early stages of construction and thus open to discontinuance of operation. Admitting that it would probably cost less to-day to build a ship than the Shipping Board's contracts call for, Commander Ackerson, discussing the proposal to carry out the original programme, said: "While this money is an emergency fund, I did not feel that we were justified in taking the possible risk that we would take if we were business men with this money at our disposal for our own profit or loss. That would be a different thing. If I had all this money I would not be a bit afraid to do it."

A Hitch in Re-adjusting Contracts

The spokesman for the Shipping Board conveyed the impression that shipbuilders holding contracts with the Government have not responded as promptly and adequately as might be wished to requests from Washington for information as to the exact status of each ship upon which work was ordered suspended after the signing of the armistice, the desire of the officials being to have this information in hand as a basis for determining whether the respective contracts should be adjusted and canceled or carried out as originally contemplated. That the Federal shipbuilding directors have all along had in mind the possibility that Congress would elect to complete the shipbuilding programme and dispose of the ships in the open market or otherwise was attested by the letter which Chairman Hurley sent to all contracting shipbuilders under date of May 12, 1919—six months after the signing of the armistice—in which he called attention to the fact that existing appropriations for shipbuilding would be exhausted by July 15, and suggested that shipbuilders revise their contracts, adapting them to present conditions of material and labor costs and naming a new flat price on all contracts entered into on the cost-plus basis, so that Congress, if disposed to carry through the uncompleted programme or any portion of it, would be in possession of information as to the exact cost.

Substitution of New Types of Vessels

In the quiz in the Senate Committee, Senator Jones and other Senators endeavored, but without conspicuous success, to wring from Chairman Hurley confession that the suspensions of shipbuilding contracts that have been made (where suspension is not equivalent to cancellation) have been ordered with the idea of the substitution of new types of ships. Mr. Hurley admitted that the Shipping Board "had substitutions in mind" but insisted it did not suspend for that purpose solely. He added that there were few yards in the country that could construct the large types of ships that would be contemplated in substitution.

Throughout the hearings there has been manifest a conviction on the part of the Shipping Board officials that the Government has an ill-balanced fleet and one not adapted to post-war conditions,—is, in fact, overstocked with smaller ships and with vessels of a speed of only 8½ to 9½ knots, in contrast to the steamers of higher speed demanded by current conditions. This is, of course, in line with the recommendations of the committee of shipbuilders and ship operators which, while counseling the completion of all steel steamers of over 9,000 tons, declared specifically, as a matter of future policy, for the construction of the larger type, shelter deck, cargo steamers of 11,000 to about 15,000 tons total deadweight capacity and capable of maintaining a sea speed of at least 12 knots. Chairman Hurley, in one of his conferences with the Senate Committee, declared: "We need seventy-four or a hundred 12,500-ton ships." He had also, he indicated, come around to the way of thinking of the shipbuilders and ship operators that the Government has been building entirely too many vessels of less than 5,000 tons. The advisers in the industry recommended that the Government sell approximately one-half of the steamers of a capacity of 5,000 tons or under, selling with the right to transfer flag, but Mr. Hurley in his latest expressions at the Capitol has voiced doubt whether it will be possible to sell advantageously all these smaller and slower ships which, as he put it, "cannot compete with our competitors on the other side."

Rosseter Favors Reinstatement of Contracts

The problem of substitution and kindred questions has been discussed at length with the Senate Committee by J. H. Rosseter, Director of Operations of the Emergency Fleet Corporation. Mr. Rosseter's qualification for rendering judgment on these considerations arises in the main part out of his recent experience in the organization of the operation of the ships owned by the Shipping Board,—the direction of trades, fixing of freight rates, manning of the ships, etc.—Mr. Rosseter has, in the interest of the maintenance of the shipbuilding industry, urged, from the time that the question arose with the signing of the armistice, that in so far as possible the suspension of contracts should be made with reference to reinstatement.

Outlining the evolution of the policy of re-alinement in ship construction which has been worked out in the Shipping Board to meet post-war conditions, Director Rosseter explained that as early as February of this year

his division had prepared tentative plans for four new types of ships for service on the Pacific,—namely, a 10,000-ton ship, a 12,000-ton type, a 15,000-ton type, and a special type with internal combustion engines. His eagerness to have American shipbuilding effort shift to the production of the most efficient and economical type of ship is ascribed to the belief that a successful American merchant marine will be practicable only if "we have the right instruments to survive the dull times of shipping." Detailing another step in the "rearrangement" of the fleet, Mr. Rosseter pointed out how 154 coal-burning steamers under construction or under contract in Great Lakes yards have been changed to oil burners, with a consequent increase of one-third in steaming radius and a gain in cargo space.

Picturing the complications that necessitated quick rearrangement of the shipbuilding programme after the cessation of fighting, the Director of Operations said: "First, our ships were built in too large numbers. We had an excess of wooden ships and we had an excessive number of small ships, so-called lake type. The next great factor is the matter of making speed. We, of course, have made no provision at all for fixed freight and passenger ships, so-called liners, and practically no provision at all for a ship of partial refrigeration. We have four refrigerator ships, but no partial refrigerator ships. Many of these changes could be made very easily. Some of them are more difficult. Where we asked for types of propulsion that are not economic, it was a rather serious thing, itself, because the engines had already been contracted for or we had been obligated under a definite contract, and the work had proceeded so far that suspension was difficult to figure; but in all of these instances we tried to approach it from a standpoint of not interfering with the yard and to have a type of ship that would be fairly interchangeable, in the main, in its principal parts."

Operating Costs in the American Merchant Marine

Discussing at one point in his testimony the relation of shipbuilding to operating costs in the American merchant marine and the chance for American shipping to hold its own in world-wide competition, this specialist said significantly: "Our ships must be built on a basis no higher than and, if possible, not as high as those of our competitors. We will win when we can get down to a cheaper basis, and that is one of the reasons why I have been so insistent in this matter of cost. We can build ships as cheaply as they can be built abroad. I have visited every large shipyard in the world. That is a broad statement, but it is true—Japan and China, as well as Germany and England and the United States. I have had some experience with shipbuilding, and I am absolutely convinced, and I will also confess that my wish probably strengthens me in that conclusion, that unless we can build the ships as cheaply as anyone else, when we have to pay more for seamen, we are bound to fail. One by one the larger shipbuilders come to me and tell me they believe I am right."

In answer to questions, Mr. Rosseter endorsed, in effect, what had been said by other practical men who have appeared before the Congressional committees as to the difficulty of ascertaining on what price basis British shipbuilders have been taking contracts since the signing of the armistice. He said that he had information from a source that he believed to be authentic to the effect that one British shipbuilding firm has taken a contract for a straight cargo ship at a rate of approximately $137 (28/10/10) a ton. On the other hand, he had heard of contracts on a basis of 55 pounds sterling ($260) per ton, which is, of course, considerably more than the cost of construction in the United States. Emphasis was laid in this connection, however, that it is not so much British competition that the American shipbuilders must face, but Japanese shipbuilding, in which latter industry, Mr. Rosseter pointed out, there is considerable construction at a rate of $50 (10/8/4) per ton below the United States cost.

For all that Mr. Rosseter subscribes in a general way to the leaning to larger ships, he does not want to overdo it, and has a good word to say for what is known as the Hog Island type of ship. In elaboration of the theory that "you do not want too many large ships" and that the 7,500-ton ships must be taken into account in the balance of the mercantile fleet, he called attention to the record of the British firm that built a fleet of 31 ships of 7,200 tons which came, in time, to have a reputation all over the world as "the most available for any trade." Regardless of size of ship, however, the desire on the part of the Shipping Board is to obtain higher speed. Speaking to this text, Mr. Rosseter said: "The old custom of building a ship of eight or nine knots, a tramp ship, has been gradually passing into the background. Therefore, we want to come from the rear to the front in the matter of speed, at a reasonable cost for the accomplishment of speed. Increased speed may be accomplished very easily up to 12½ knots."

The Case of the Pacific Coast Shipbuilders

Shipbuilders on the Pacific Coast have been represented at the hearings by Harrison S. Robinson, of Oakland, Cal., who has stated that for most of the yards on the west coast the situation is one that will involve their life or death during the next few months. Skepticism has been expressed that the basis of contract cancellation contemplated by the Shipping Board does not afford adequate reimbursement to the shipbuilders, and the earnest plea put forth that the "chopping off" of Government contracts be done in such manner as to "enable the yards to tie on to the end of their Government programme the beginning of their private programme."

It is the contention of the Pacific Coast shipbuilders that there is no need for drastic or precipitate action because there is an undoubted market for such tonnage as would have to be built to Government contract to enable the yards to bridge the gap and continue moral activity up to the point where Government work could be replaced by private operations. Furthermore, it is urged that the Government should pursue no course that would not amount to a determination by the Government which yards shall survive and which shall cease operation, but that, instead, all of the yards should have a chance at a running start to continue business.

President H. A. Evans, of the Baltimore Dry Docks and Shipbuilding Company, is the only Eastern shipbuilder to testify thus far before the committee. He stated that the position of this company was not as serious as that of some of the Pacific Coast plants, but that unless the Shipping Board authorized, within thirty days, the continuance of work on contracts in hand, it would be necessary to begin to lay off men. Mr. Evans explained the tardiness of response of which Shipping Board officials complained by stating that shipbuilders have found it a most tedious proceeding to obtain from their subcontractors—running into hundreds in number—statements as to the terms on which contracts could be cancelled or adjusted. Some of the subcontractors, it was pointed out, are declining absolutely any form of compromise, and assert an intention to hold shipbuilders to the terms of original contracts.



Fig. 1.—West Street New York. Fifty Millions Are Spent Annually in Handling Freight Within the Corporate Limits of New York City, of Which More Than Half Is Expended at Marine Terminals

Motor Trucks and the Problem of Efficient Marine Freight Terminal Operation—I

BY MERRILL C. HORINE

This series of articles will deal specifically with the adequate use of motor trucks as freight terminal carriers. In clearing the ground, however, for this subject, the author has drawn from his wide experience in the complex phases of economical terminal operation, so that the paper is, in a sense, a complete survey of the terminal operation field. Mr. Horine discusses in this first instalment the inter-relation of carriers—railroads, transfer drays and steamships—with piers and warehouses; he takes up the problem of centralized control at terminal points to cover the overlapping functions of these agents; he analyzes carefully the special functions of the pier and warehouse, taking a fling at the antiquated American custom which permits the stoppage of traffic by allowing free time privilege on piers before he swings into a discussion upon vehicular service which bears directly upon the use of the motor truck in this work.

—The Editor.

MARITIME supremacy will not be won for America on the high seas alone. Building ships, deepening harbors, training personnel and extending the market for American products will be in vain unless transportation on the land is properly wedded to that on the sea. The marine terminal is the neck of the bottle out of which must pass our exports and through which our imports must come.

World trade competition is a matter of quality and price. Manufactured goods must be the mainstay of our export trade, although it costs us more to manufacture, for materials, labor and land, than any other first-class power. Trade in raw materials is largely a matter of cost of transportation, since transportation is the greatest cost in dealing in crude stuffs. We must reduce transportation costs in spite of the fact that it costs more to operate an American merchantman than one under any other flag. Costs can be reduced where there is greatest waste, and to effect substantial reductions in the total requires marked decreases in the largest proportionate items.

Not on the sea, but on the land, the greatest expenses are incurred, and it is here that the most appalling waste is found. Yankee seafarers in the navy and the merchant marine acknowledge no superiors, but our marine freight terminals are the poorest in the world. To carry on an extensive ocean commerce we must be able to keep our ships moving so that their operation may be more economical. We must load and unload them quickly. To effect this and to reduce the staggering terminal charges, we must operate our marine terminals more economically. It is a fortunate economic circumstance that operations which are sped up are usually performed more cheaply. The slowest way is usually the least effective and the most extravagant.

Nearly everything that is shipped out of the country and brought into it by water has also to be transported by land for considerable distances. The export problem is more than water transportation; economies in contributing land transportation are quite as important as in water transportation.

It costs as much to deliver a shipment from a railroad freight terminal in the New York district to the hold of a ship as it does to transport it by rail from Chicago to the New York freight terminal. The 1,300-mile marine haul from Havana to Boston is cheaper than the transfer from one pier in Boston harbor to another. A bale of cotton may be shipped by water from Savannah to New York at less cost than it can be raised from the hold of the vessel and transferred to a Brooklyn warehouse.

The average railway freight haul in this country is about 250 miles. At this average haul the terminal charges are about equal to the freight tariff—75 cents (3/1½) average.

Antiquated, slow and expensive as much of the ship-unloading is, the excessive terminal charges for marine transportation cannot be laid to this cause. Handling a cargo between the point of origin or destination and the side of the ship costs about fifteen times what it does to load or unload the ship. This cost is in haulage over streets and roads, trucking over platforms and through buildings, weighing, checking, rechecking, loading and unloading into vehicles and platform trucks.

> "One reason why our exports have not aggregated greater tonnage in the past is that it has been impossible for our railroads to deliver adequate freight to the seaboard. A recent compilation of records of 2,000 freight cars on 144 railroads showed the average daily mileage of 26 miles covered in two and one-half hours, giving a moving factor of about 10 percent and representing but little improvement in speed over the stage of Colonial times. On the other hand, railroads are affected by marine terminal traffic as well, and it is entirely reasonable to suppose that an improvement in ship-unloading arrangements saving only two and one-quarter hours a day would approximately double the effectiveness of the railroads and thereby enable them to handle twice the present daily volume of freight."—Merrill C. Horine.

Marine Freight Terminals at Fault

The fault lies fundamentally in the lack of proper correlation between (a) the steamship, (b) the railroad, and (c) vehicular traffic, which is to say that the marine freight terminal, the natural junction of these three, does not fulfill its mission properly. In many instances the steamship, the pier, the warehouse, the railroad and the trucking interests are independent units. No one interest is responsible for the terminal facilities. Viewing the situation narrowly, each interest performs its particular function as nearly independently as possible, adapting itself to conditions and charging accordingly for its service. Each agent realizes to some extent to what degree its operations are limited by conditions beyond its control and beyond the control of any one interest, and, accordingly, would regard with the utmost favor a co-operative effort to eradicate the many



Fig. 2.—Bush Terminal, Brooklyn, N. Y. The Warehouse Has Been More or Less Neglected as an Important Factor in Marine Freight Terminals. It Is True That a Few, Such as Bush Terminal, Have Been Provided with Warehouses Back of the Bulkheads, But These Are Not an Integral Part of the Terminal, Nor Do They Act as Clearing Houses for Freight



Fig. 3.—West Shore Railroad Terminal, Weehawken, N. J. Improvement in Ship-Unloading Arrangements Saving Only 2¼ Hours a Day Would Approximately Double the Effectiveness of the Railroads and Would Eliminate the Congestion at Railroad Terminals Which So Hampers Expeditious Exchange of Marine Cargoes

evils which have been allowed to grow through the perpetuation of antiquated equipment, methods and relations.

Nor can the transportation interests unaided solve this difficulty. It is a situation affecting and affected by every element of foreign commerce. If the importers and exporters of this country, looking forward to successful competition in world trade, had any conception of the almost hopeless inefficiency of freight movement at our ports, or if they could realize how enthusiastically shipowners, terminal operators and carriers would welcome their awakening to the necessity of improvement, American travelers could look upon such ports as Hamburg and Rotterdam without blushing for New York.

Stringent Regulation of Terminal Conditions Needed

As long as any American shipper or receiver of freight is allowed the excessive free time at terminals which he now takes, as long as any merchant can use a steamship pier for a warehouse at bargain rates, and as long as any private vehicle is allowed undisputed access to any terminal at its owner's pleasure, just so long will every user of transportation demand these privileges. Under these conditions efficient operation of the terminals is impossible.

The first railroads in this country were merely railed roads on which any shipper might operate his own flange-wheel wagons for the payment of toll. The present low freight charges, averaging 3 mills per ton-mile, are possible through centralizing operation and control of railroad rolling stock—the establishment of a monopoly on the right of way, if you please.

Similarly terminals will become efficient only when they are properly equipped and controlled as ship-unloading and loading appliances. They cannot be successfully operated so long as they are merely piers for ships to tie to or wharves upon which shippers may dump their cargoes.

One reason for the inefficiency of American marine terminals is the fact that their construction has been regarded as a purely architectural matter. More efficient facilities would be provided if engineers of economics were given an opportunity to work on them. American piers are too narrow, as a rule; they hold about a third of a shipload; they rarely have direct railroad facilities. They do not even provide means for getting the goods to vehicles, but are built with the idea that the vehicle will go to the goods—and, at that, make no provision for the efficient movement of vehicles on and off the piers without obstruction.

> "Is it any wonder that motor trucks cannot work effectively under present conditions when, at $2 (8/4) standing cost, for example, the average vehicle is obliged to wait from 2½ to 3½ hours for a chance to load at a marine terminal and only slightly less time to unload? Cases are common where a vehicle must wait in line for as long as two days to unload l.c.l. export freight. Last winter the lines were so long that teamsters, in order to keep their places in line, unhitched their horses and led them to the stables overnight, resuming the long vigil in the morning, and sometimes on a third day."—MERRILL C. HORINE.

Possibility of Reducing Expense at Terminals

One-third of the gross tonnage transported by rail in the United States is either shipped overseas from the rail destination or originates as overseas imports. Fifty millions (£10,250,000) are spent in handling freight within the corporate limits of New York city alone. This amount does not include that part of the port of New York which is on the New Jersey side. Here is our biggest waste. It now costs on an average of 37 cents (1/6½) per ton to handle marine freight at New York. If this charge could be reduced 5 cents (0/2½) per ton by more efficient methods, shippers would save well over $3,000,000 (£615,000) a year.

But it would mean more than this. Wherever costs are reduced by quicker and simpler operations, the volume of business possible with the same facilities is increased, often in greater proportion, and the profits thereby multiplied. There is no question but that American port facilities are susceptible of being greatly increased in capacity. New York habor averages 150 tons of cargo per annum per foot of bulkhead or pier. Marseilles, for

example, averages 500 tons. On this basis the present terminal facilities at New York would be adequate for three and a half times the tonnage now handled if operations could be sufficiently expedited.

Efficient Terminals Increase Shipowners' Profits

These facts should be sufficient to convince shippers of the paramount importance of improving marine freight terminals, but this is not the only advantage to be derived. Vast economy and greatly increased earnings for shipowners are involved, since such an acceleration of loading and unloading operations would mean less idle ship time in port. It costs about $1,000 (£205) a day to hold an average coastwise or tramp steamer in port, and about $3,000 (£615) a day for an ocean freighter. There is no reason why ships in Atlantic trade should require twelve weeks per round trip, when their engines are capable of driving them across in half this time with reasonable time in port to take on and discharge cargo.



Fig. 5.—Typical Mid-Day Congestion on West Street, New York

Just as slow unloading of ships impedes railroad traffic, so slow railroad traffic impedes ship movement. The moving factor for railroads is even lower than that for steamships. A recent compilation of records of 2,000 freight cars on 144 railroad lines showed the average daily mileage to be 26, covered in 2½ hours, giving a moving factor of about 10 percent and representing but little improvement in speed over the stage of Colonial times. One reason why our exports have not aggregated greater tonnages in the past is that it has been impossible for our railroads to deliver adequate freight to the seaboard. We were rudely awakened to the situation by the war. Since the railroads, on the other hand, are affected by marine traffic, it is entirely reasonable to suppose that an improvement in ship-unloading arrangements saving only 2¼ hours a day would approximately double the effectiveness of the railroads and thereby enable them to handle twice the present daily volume of freight.

Proper Functions of a Pier

To effect this saving through the acceleration of freight movement through the terminals, it is a fundamental necessity that the proper function of the steamship pier be recognized clearly and that its use be permitted exclusively for this purpose. The mission of the pier is to serve as a berth for the vessel and as a platform upon which the vessel may discharge its cargo or from which it may take its cargo.

Under ideal conditions, a ship, immediately upon arrival in port, should be able to warp to a clear bulkhead and discharge its load at once. If possible, such a pier should be large enough to take the entire cargo. If this is impossible, arrangements should be such that the unloaded



Fig. 4.—The Average Vehicle is Obliged to Wait from 2½ to 3½ Hours for a Chance to Load or Unload. Cases Are Common Where a Vehicle Must Wait in Line for as Long as 2 Days

freight could be removed from the deck as fast as it is raised from the ship's hold. Even where the pier is large enough to receive an entire cargo it should be possible to clear it at approximately the same speed at which the ship unloads, so that as soon as one ship has discharged its load another may take its place and commence unloading.

By the time the ship is emptied, an outbound cargo should be assembled on another pier, so that reloading can be begun immediately. Simultaneously with one or both of these operations, the ship may refuel from lighters, so that its stay in port is limited to the time necessary to discharge and take on cargoes.

This covers the terminal problem from the standpoint of the steamship company. It is natural, therefore, that shipowners should be favorable to improvement in terminal efficiency. Even though the cost of docking be increased considerably to cover the cost of improved equipment, the ship operator would save because his ship would not be eating up the profits in useless riding at anchor while waiting for a load.



Fig. 6.—Transatlantic Freighters at Anchor in the Upper Bay, New York Harbor. It Costs $3,000 a Day to Keep These Ships Waiting for Cargoes

The shipper, too, would benefit. To him it would mean quicker receipt and shipment of goods; and if an improved scheme of terminal operation meant lower terminal charges, rates might be cheaper. Certainly it would mean quicker dispatch of goods, since he would not have to wait so long for shipping bottoms, and a saving in storage.

Though the terminal operator would by this means collect his berthing charge for shorter periods per ship, he could accommodate more ships, would be warranted in making a higher docking charge, and would be able to handle a greater volume of freight. The latter gain would also entail an increased volume of goods warehoused with the possibility of charging lower rates without loss.

Free Time Privilege Halts Improvements

But there are obstacles. Chiefest of these is the free time evil. Established in the easy-going days when a day more or less in port meant nothing to the shipmaster, and when cargoes often were not sold until they had been unloaded from the ship, the practice of allowing goods to remain on the bulkhead for two days after unloading without charge is to-day the Gordian knot which the shipper cannot hope to unravel. Sooner or later a stalwart Alexander will free the terminals from their fetters by cutting this knot, and it is useless to talk terminal efficiency until that step is taken.

This does not mean that the consignee must receive his goods the hour they are unloaded, but it means that the service of the transportation company will not end when the goods have been set on dry land. It means that whatever free time is allowed will be in bonded warehouses contiguous to the wharves and to which freight will be transferred automatically by the steamship or terminal company.

Control of Demurrage and Warehouse Rates

In Philadelphia a plan whereby free time was reduced and freight segregated by the carriers was successful to the extent of increasing the freight volume 20 to 40 percent with the same force of men at some of the railroad car-float piers. Low demurrage rates are also contributory to slow movement of freight over the terminals, since, in many instances, demurrage costs the receiver less than short-term storage. With higher demurrage and lower warehouse rates for short time, goods can be made to move away from the wharves more quickly.

Function of the Warehouse

The warehouse has been more or less neglected as an important factor in marine freight terminals. The warehouse is the natural reservoir and balancer of the terminal. At peak-load periods, when freight is being received faster than it can be forwarded or is coming faster than it can be delivered, there should be a part of the terminal group in which the goods can accumulate until a low period. The warehouse, therefore, acts either to keep outbound ships supplied with cargoes when receipts are light or to supply the needed imports to the country when shipping is dull.

The warehouse is the logical place for vehicles to load and unload, and not the pier. Most of our New York piers are without warehouse facilities other than their pier sheds. Consequently, the only way in which a pier can be cleared for a new cargo is to induce shippers to come and get their goods. On the other hand, outbound shipments received early must stand in everyone's way until a ship is ready to load them.

Adaptability of Various Pier Arrangements

Several arrangements of the warehouse in relation to the pier are possible. Any of these can be made to provide the proper traffic room for trucks to operate efficiently. The European quay system has many advantages. With this arrangement the ship berths broadside to the land, and the freight may move across the quay over an exceedingly wide space to a parallel warehouse or to streets between warehouses.

The American arrangement of wide piers up to a thousand feet in length can be used in connection with warehouses on the land, provided an unobstructed traffic way is left to give two lines of traffic between the pier and the warehouse.

A pier of sufficient width, say 300 feet or more—with railroad tracks and roadways down its center, may be built up to a mile in length and several stories high, so that commodious loading platforms may be provided on the pier itself, on a different level from the main loading floor, with the warehouse occupying the upper floors. The gigantic recreation pier in Chicago is of this type. As a freight terminal, the structure would accommodate several of the largest-sized ocean steamships at one time, whole trains of cars, and would afford platform facilities for hundreds of trucks to load at once.

Handling Package Freight

Approximately a sixth of the gross tonnage transported by rail is what is termed in railroad parlance l.c.l.,



Fig. 7.—The European Quay System Has Many Advantages. Here Is Its Adaptation at the First Naval Stores Port in the World—Savannah, Ga.

or package freight. In all it has been estimated that 600,000,000 tons move across the marine freight terminals annually, exclusive of bulk shipments. Furthermore, the importance of package freight is not to be judged by the volume it assumes in proportion to the total tonnage, since the most valuable cargoes are usually of package freight and bulk shipments are ordinarily of crude materials which have a comparatively low tonnage value.

The trucking and transfer companies which move the bulk of the l.c.l. freight away from the terminals are to be considered in this connection. By horse vehicles or motor trucks these agents transfer freight from terminals to warehouses, and make final deliveries from the terminals and contiguous warehouses to the store doors of merchants.

At present, terminal efficiency means little to these interests because, whether they are able to haul large or small tonnages per vehicle-day, they exact a fee permitting a reasonable profit. Were the terminals so arranged that they might leave or secure loads directly, without waiting, shippers could and undoubtedly would employ motor trucks economically; but so long as present conditions prevail they will continue principally to use horse transportation, which can be operated at minimum overhead expense.

Some idea of the confusion, complication and hopelessness of attempting efficient vehicular movement of freight from New York terminals may be gained from the fact that trucking in New York is done by over a thousand different concerns, aside from mercantile concerns operating their own vehicles.

"It costs as much to deliver a shipment from a railroad freight terminal in the New York district to the hold of a ship as it does to transport it by rail from Chicago to the New York freight terminal. The 1,300-mile marine haul from Havana to Boston is cheaper than the transfer from one pier in Boston harbor to another. A bale of cotton may be shipped by water from Savannah to New York at less cost than it can be raised from the hold of the vessel and transferred to a Brooklyn warehouse.

"The average railway freight haul in this country is about 250 miles. At this average haul the terminal charges are about equal to the freight tariff—75 cents (3/1½) average.

"Antiquated, slow and expensive as much of the ship-unloading is, the excessive terminal charges for marine transportation cannot be laid to this cause. Handling a cargo between the point of origin or destination and the side of the ship costs about fifteen times what it does to load or unload the ship. This cost is in haulage over streets and roads, trucking over platforms and through buildings, weighing, checking, rechecking, loading and unloading into vehicles and platform trucks."

—Merrill C. Horine.

Inefficiency of Present Vehicular Service

Much of the clerical delay and cost, which is one of the most vexing obstacles to efficient terminal operation, is occasioned by this heterogeneity of vehicles and the impossibility of controlling it. It is this condition which is also responsible for the appallingly low load factor prevailing in terminal trucking. Few realize the tremendous waste which this low load factor represents.

Investigations preceding the perfection of the store door delivery project in New York showed that about 2,000 carloads of freight are received daily. During the period observed, at three piers alone 1,100 vehicles arrived to pick up goods for delivery to New York consignees. Ninety-one percent came to the piers empty and the average load taken away was 57 percent of the respective capacities of the vehicles. These 1,100 vehicles could have delivered 2,200 tons, but they actually delivered but 182, yet to have delivered the lost 2,018 tons would have cost practically nothing more, and with efficient arrangement for loading and the elimination of excessive clerical delays the

entire transfer of this tonnage could have been performed in less time than was absolutely lost by the long waiting in line for a chance to get on the piers.

Is it any wonder that motor trucks cannot work effectively under present conditions when, at $2 (8/4) an hour standing cost, for example, the average vehicle is obliged to wait from 2½ to 3½ hours for a chance to load at a marine terminal and only slightly less time to unload! Cases are common where a vehicle must wait in line for as long as two days to unload l.c.l. export freight. Last winter in New York some of the lines were so long that teamsters, in order to keep their places in line, unhitched their horses and led them to their stables overnight, resuming the long vigil the next day, and sometimes on a third day.

Investigations of the Highways Transport Committee have shown that in New York the average time for loading and unloading a vehicle at a marine terminal is 3 hours; the average load is slightly less than 1 ton. Cases have been cited in which at some of the largest and most famous of New York's newer terminals 11 hours have been consumed in loading one truck.

(*To be continued.*)

Ship Repaired in Record Time

AFTER having her rudder and rudder post carried away in a storm while crossing the Pacific, the *Yomei Maru*, owned by the Ocean Transport Company of Japan, was repaired in record time by the Skinner & Eddy Corporation, of Seattle. The ship was repaired in 20 days.

The *Yomei Maru* was docked at the Skinner & Eddy yard the morning of May 30. The work of backing out the rivets in five stern plates was immediately commenced and the plates removed, the stern frame taken out, and the propeller and tail shaft also removed. This work was completed the following day in twenty-nine hours. After being sealed the ship was undocked.

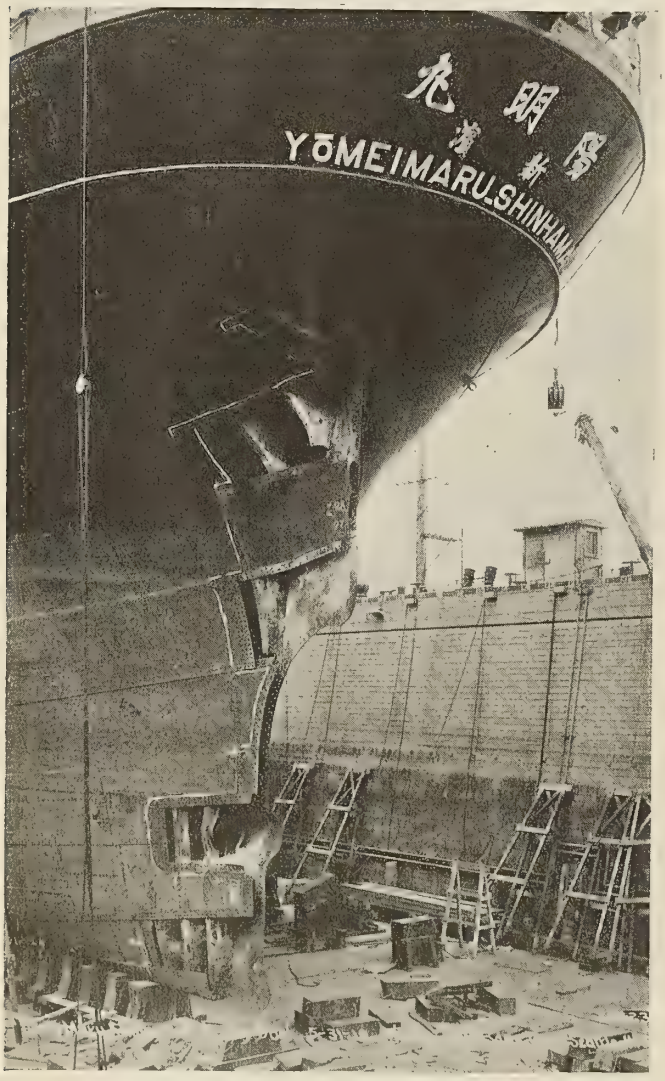
Stern Frame Installed

At the outset of this dismantling work it was necessary for the men to cut through a great thickness of cement in the after peak tank, in order to get at the rivets.

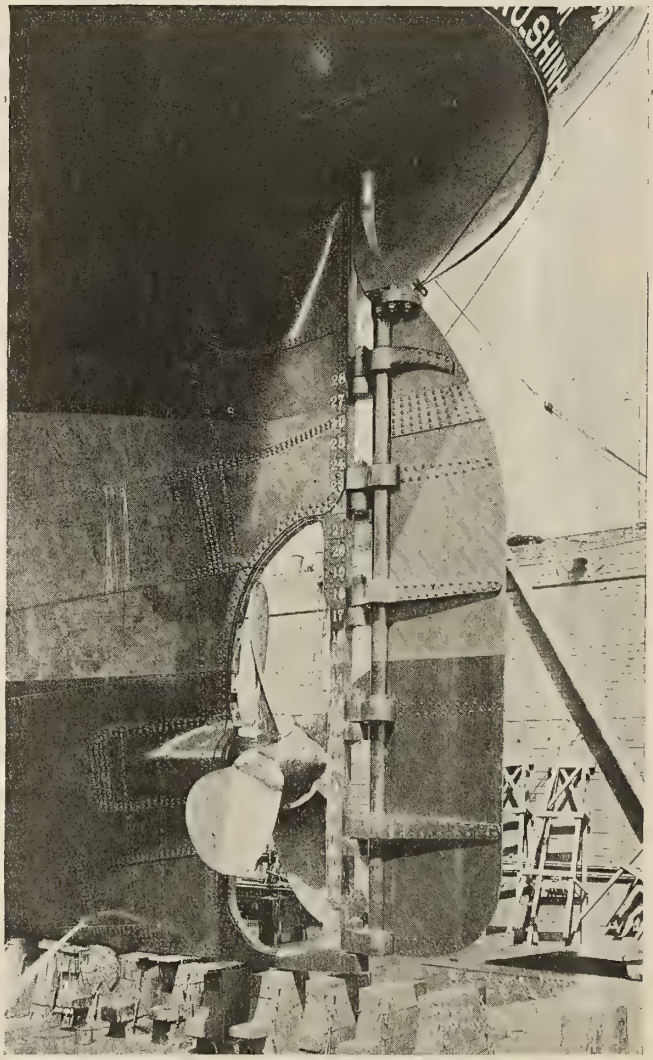
In the meantime, the East Waterway plant of the Pacific Coast & Engineering Company, the largest heavy forging plant west of Pittsburgh, had started on the new stern frame and rudder post forgings. On the morning of June 13 these were delivered at the yards, and the ship was again docked for their installation.

On June 14, the stern frame was in place, and the new plates ready for riveting. The stern frame was then bored for the tail shaft and the rudder and the propeller shipped. All that remained was the final test of the after tanks, after which the ship was floated and returned to commission.

The extent of the repairs may be understood from the size of the rudder, which is 32 feet long, 5 feet wide, and, including its fittings, weighs about 10 tons. The stern frame weighs 20½ tons.



Stern Frame and Plates Cut Away



Repairs Completed in 20 Days

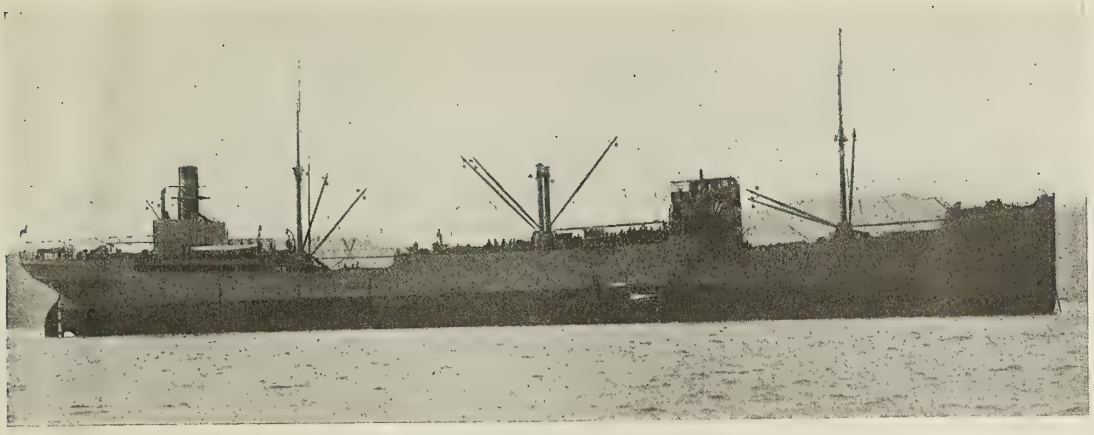


Fig. 1.—Motorship *Ansaldo San Giorgio I*

Italian Motorship Ansaldo San Giorgio I

Description of Cargo Motorship of 8,100 Tons Deadweight Built and Engined by the Ansaldo San Giorgio Company of Italy

BY ARTHUR BENINGTON

THE motorship *Ansaldo San Giorgio I,* the first of several similar ships already under construction, recently began her sea service after being launched and fitted out in the shipyard of the Ansaldo San Giorgio Company at Muggiano, Italy.

Classified as 100 A.I.I.L. in the Registro Nazionale Italiano, and in Class B.S. of the British Corporation, she is of the single-deck type, with special framing, which leaves the cargo holds entirely unobstructed by pillars or stanchions, thus greatly facilitating loading and unloading operations. Her principal dimensions are as follows:

Length overall	393 feet 11 inches
Length between perpendiculars	378 feet
Beam, extreme	51 feet 9 inches
Beam, molded	51 feet 6 inches
Load draft	24 feet 6 inches
Deadweight tonnage	8,100
Gross tonnage	5,580
Brake horsepower	2,200
Speed (full load)	11 knots

The ship is rigged with two masts, which serve also as derrick posts for the handling of cargo. Large compartments amidships and aft furnish up-to-date and comfortable living quarters. In the amidships house are cabins for the captain and officers, also the wireless station, galley, pantry and crew's quarters; in the poop are quarters for the engineers and firemen, and in the fore part of the same is the donkey boiler room. All these are steam heated and have electric light.

The propelling machinery is located in the stern. The cargo space, forward and amidships, is divided into six holds. By means of eight watertight transverse bulkheads, the vessel is divided into nine watertight compartments, giving complete assurance of buoyancy in case of accident to any part of the hull. The foremost and aftermost of these compartments (trimming tanks) can contain, respectively, 4,273 and 4,450 cubic feet of water ballast.

The vessel has a cellular double bottom throughout, divided into six compartments, the after three of which are used for fuel oil for the Diesel engines and donkey boilers, while in the others, 31,783 cubic feet of mineral oil can be carried. Every compartment of the double

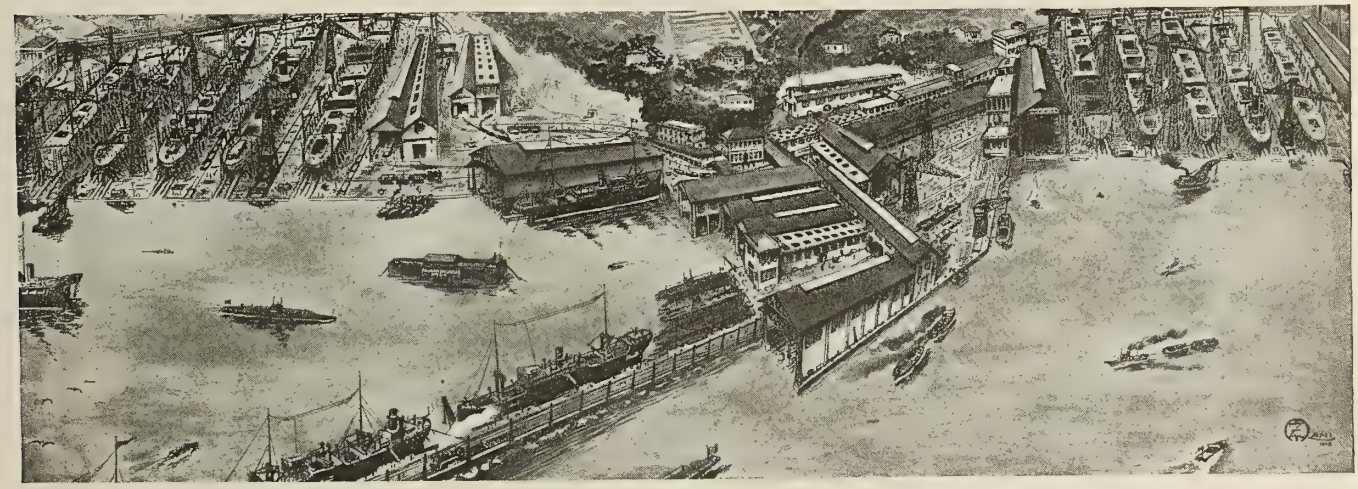


Fig. 2.—Shipyards of the Ansaldo San Giorgio Company, Muggiano (Spezia). From a Sketch

bottom can be filled and emptied by means of the auxiliary pumps.

The propelling machinery consists of two single-acting two-cycle Diesel engines built at the Turin shops of the Ansaldo San Giorgio Company. The two engines together develop 2,200 brake horsepower at 100 revolutions per minute, and each has four cylinders, 20 13/16-inch bore by 35 7/16-inch stroke; they are of the reversible type, alike in details and symmetric in arrangement.

All auxiliaries, such as scavenging pumps, air compressors, oil pump, water-cooling pump, etc., are driven directly by the main engines, being placed on continuations of the crankshafts forward of the engines, thus avoiding any lateral encumbrance of the motors.

The exhaust gases pass into silencers, and a complete system of ventilators assures good ventilation of the engine room.

All operations of starting and reversing the engines can be made from the central platform, where a complete set of manometers and other controlling apparatus permit easy surveillance of the Diesel engines and of all the auxiliary machinery.

The several operations of steering the ship, handling the cargo, filling and emptying the double bottoms, etc., are performed by means of a complete set of modern auxiliary engines, consisting of windlass, eleven winches for hold service, steering gear, electric generator of 5.5 kilowatts and 110 volts for illumination, air compressor for charging the tanks that supply compressed air for starting the Diesel engines, auxiliary condenser for the exhaust steam of the auxiliaries, water distiller with a capacity of 10 tons daily, pumps for ballast, fire and sanitary service, liquid fuel, etc.

All auxiliaries are steam-driven, the power being furnished by two oil-fired vertical type Blake boilers, installed in the forward part of the aft house. Each boiler can supply sufficient steam to drive two-thirds of the auxiliaries at one time.

This is the first of this type of vessel to go into commission, and her performance is arousing the deepest interest among marine engineers and shipowners. The *Ansaldo San Giorgio I* completed her maiden voyage on June 1, when she reached Genoa after taking a full cargo of ore from Cartagena, Spain, to Glasgow, returning laden with coal for Italy. In spite of bad weather throughout the voyage, she averaged eleven miles an hour, with a daily consumption of ten tons of fuel oil.

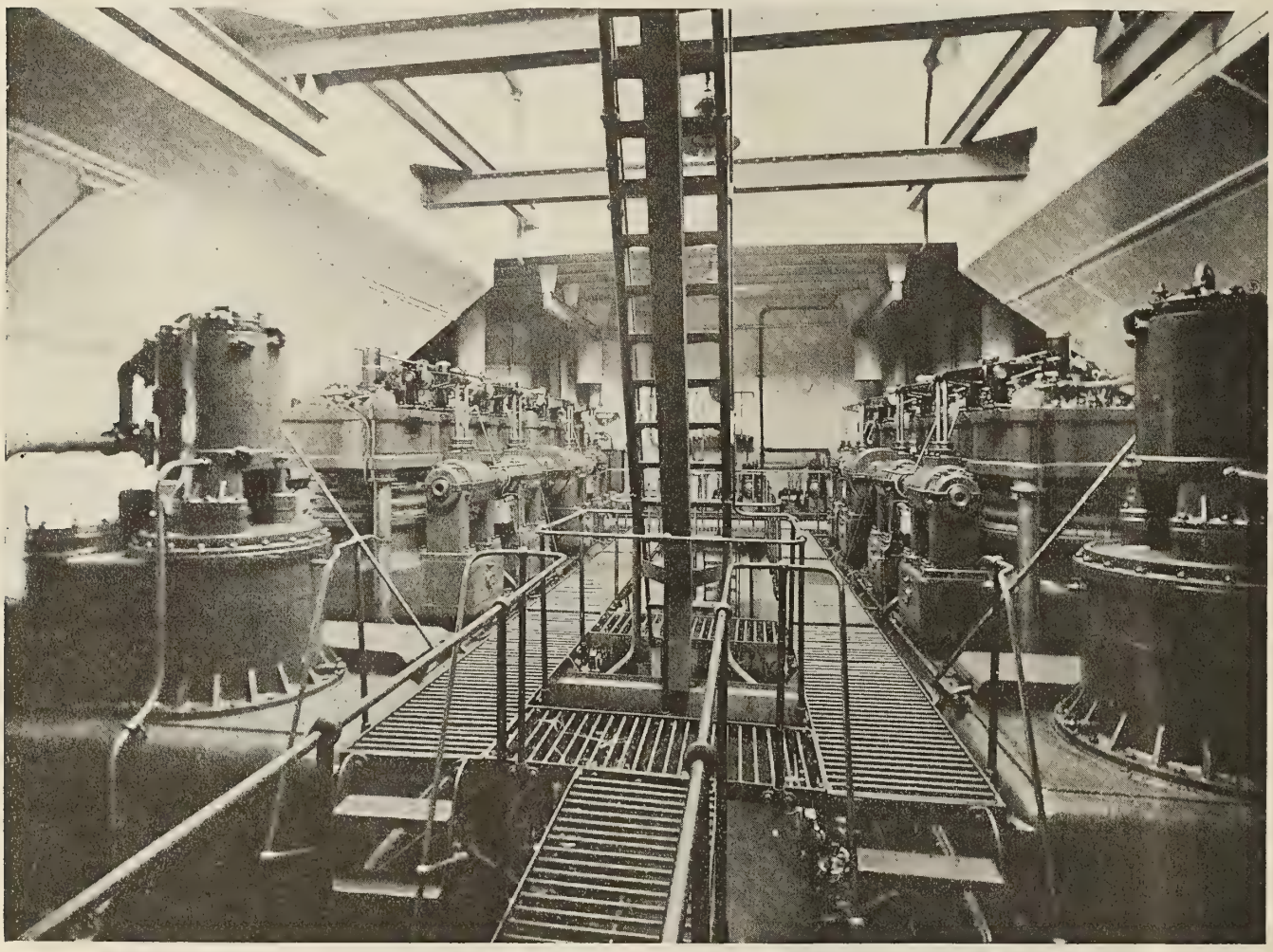


Fig. 3.—Engine Room of the *Ansaldo San Giorgio I*

The Ansaldo San Giorgio Company, her builder, was until recently the Fiat San Giorgio, under which name it won a world-wide reputation. During the war, Giorgio Ansaldo & Company, the great engineering and shipbuilding concern of Genoa, bought a controlling interest in the company and changed the name to conform with its own. The plant of the company consists of the shipyards at Muggiano (Spezia) and the engine works at Turin.

After long experience in the building of steamships (of which more than forty were built, some of these



Fig. 4.—The Assembly Shops at the Ansaldo San Giorgio Company's Engine Works, Turin



Fig. 5.—Interior of the Ansaldo San Giorgio Company's Engine Works at Turin

being about 20,000 tons displacement), the company decided to devote its facilities especially to the building of motorships. On the basis of tests and practical results, the engineers of the Ansaldo San Giorgio Company decided to devote themselves exclusively to the construction of the two-cycle engine, which presents the following advantages over the four-cycle:

1. Development of greater power, giving as a consequence considerable saving in weight, which can be calculated as approximately 35 percent.

2. Greater facility for reversing, and therefore much less complicated mechanism.

3. Elimination of exhaust valves, which in the four-cycle engines are a source of trouble, being very sensitive to the quality of the fuel and easily damaged by the asphalt and sulphur contained in certain qualities of heavy oils; the two-cycle engine, without exhaust valves, can consequently use certain kinds of fuel which are not suitable for four-cycle engines.

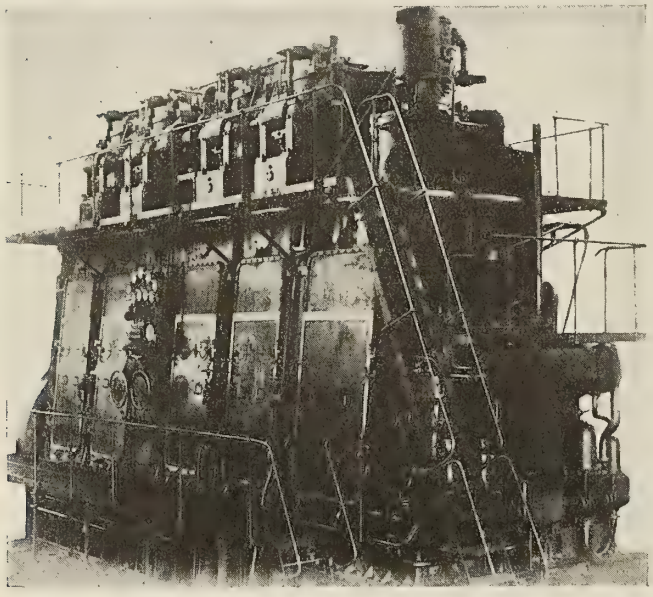


Fig. 6.—1,500-Horsepower Diesel Engine Built by the Ansaldo San Giorgio Company

4. Much more regular moment of torsion, an advantage that resolves itself practically into a smaller intensity of vibrations of the ship and a reduction in the dimensions and weight of the line shafting and of its accessories.

It is likewise to be noted that the smaller dimensions of the flywheel make it possible to place the engines nearer the stern of the ship, so that there is not only a saving in the length of the shafting but also an increase in the space available for cargo.

The real merits of the two-cycle Diesel engines, united with the perfection in construction attained by the engine works at Turin, permitted the Ansaldo San Giorgio Company to build the series of submersible torpedo-boats that are so well known and appreciated in Italy and abroad for the special construction of the hull (Laurenti's patents) and for the perfection of their propelling machinery, which consists of two-cycle Diesel motors of 350 to 1,300 brake horsepower. More than 92 of these submarines have been built in the shipyard at Muggiano for the navies of Italy, Brazil, Denmark, England, Portugal, Spain, Sweden, the United States and Russia. At the same time the engine works at Turin constructed about 250 engines with a total of more than 200,000 brake horsepower. Later on the motorship *Ceara,* 4,100 tons displacement, with two engines of 2,300 horsepower, was built, and then the latest series of motorships of 12,000 tons displacement with two engines of 1,600 horsepower.

Encouraged by the practical results already obtained, the Ansaldo San Giorgio Company looked for a standard type of motorship that should possess the highest qualities of economy, efficiency and reliability. After long and careful study its choice fell upon the type of motorship of 8,100 tons deadweight capacity, of which the *Ansaldo San Giorgio I,* described above, is the first example.

The economic superiority of the modern motorship over the steamship and its advantages may be summarized as follows:

The weight of the fuel used by the internal combustion engines is much less than the weight of the coal necessary for the steam engine, so the motorship can carry cargo where the steamship must carry fuel, thus obtaining a considerable increase in profit.

The power developed by the engines of the motorship and steamship being equal, the cost of the liquid fuel used in the former is notably inferior to the cost of the coal burned by the latter; thus the motorship realizes another large saving in money.

The operations of loading the liquid fuel are accomplished with more cleanliness than the corresponding operations for the coal.

The management of the Diesel engine requires a reduced engine room staff and no firemen.

A single, simple example will show these advantages as follows:

For the two-cycle marine Diesel engines built by the Ansaldo San Giorgio Company a fuel consumption of not more than 0.43 pound per brake horsepower hour was obtained. On a steamship the coal consumption, including auxiliary machinery, is usually in the neighborhood of two pounds per indicated horsepower, or 2.35 pounds per brake horsepower.

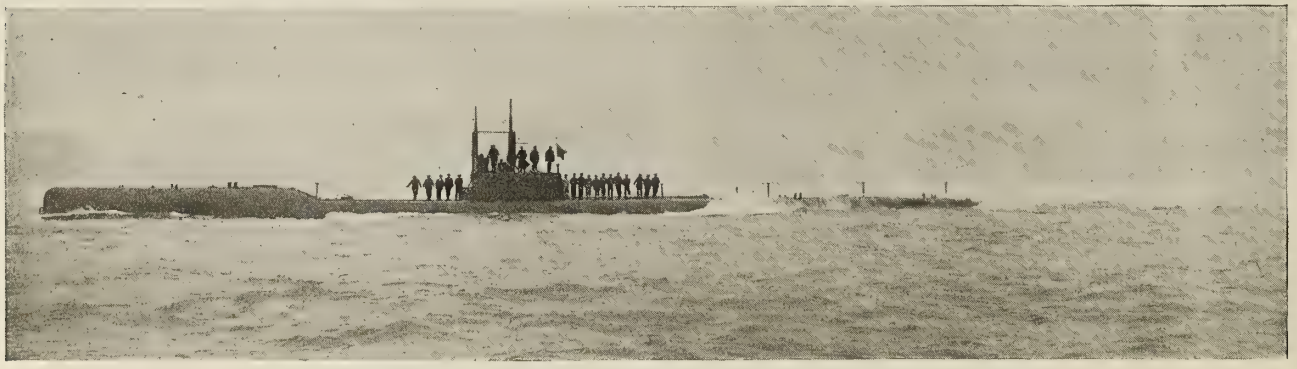


Fig. 7.—Italian Submarine Built and Engined by the Ansaldo San Giorgio Company

Therefore the motorship *Ansaldo San Giorgio I,* with her engines of 2,000 horsepower, burns 0.384 ton of heavy oil per hour. Starting with 250 tons of fuel, she can run 650 hours. With her speed of 11 knots she can run a distance of 7,150 miles, carrying 8,000 tons of cargo.

A steamship of the same capacity, with steam engines of the same power and speed, will burn 2.1 tons of coal per hour. For running the same distance of 7,150 miles, she must carry in her bunkers 1,360 tons of coal, carrying, therefore, only 6,890 tons of cargo.

What will be the financial result of the voyage for the two ships?

Neglecting the savings of the motorship in reduced engine room staff, ease of loading the fuel, etc., let us consider only the greater profit obtained from the greater cargo capacity and the saving in money in reduced consumption of fuel. Referring to actual prices* we can calculate for a voyage like the one assumed, a freight of 150 shillings a ton of cargo, cost of oil 140 shillings a ton, cost of coal 80 shillings a ton. Thus we shall have:

MOTORSHIP

	Shillings
Freight for 8,000 tons of cargo at 150 shillings	1,200,000
Cost of 250 tons of oil at 140 shillings	35,000
Profit	1,165,000

STEAMSHIP

	Shillings
Freight for 6,890 tons of cargo at 150 shillings	1,033,500
Cost of 1,360 tons of coal at 80 shillings	108,800
Profit	924,700

Thus the motorship will realize a profit greater by 240,300 shillings than the steamship in a single voyage. probably eight such voyages can be made in one year, so that for a motorship like the *Ansaldo San Giorgio I,* compared with a similar steamship, the greater profits and savings may amount to a total of £96,120 sterling, or about $467,000 per annum.

The difference in initial cost of the two vessels is only about $487,000 (£100,000).

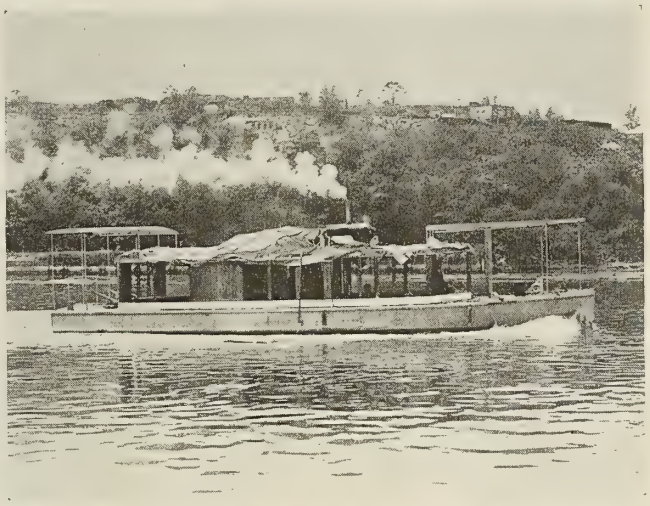
Launch Designed for Explorer

A RATHER unique type of launch has been built for Dr. Hamilton K. Rice, of Boston, by the Consolidated Shipbuilding Corporation, Morris Heights, N. Y. The boat will be used on his fifth trip of exploration along the Rio Negro river in Brazil. This launch is the development of a peculiar tunnel stern construction successfully used on previous boats built for Dr. Rice by the same company. It is well adapted to the navigating of shallow waters, and the protection afforded the rudder and the propeller by the tunnel enables the boat to negotiate small rapids and other obstructions without difficulty.

The boat is 45 feet long with a 14-foot beam and a draft of 2 feet and is built to withstand rough usage. Her power plant consists of a 30-horsepower, 6-inch by 6½-inch air-starting Mietz kerosene (paraffin) engine, equipped with a Delco ¾-kilowatt generating set for supplying current to the electrical equipment. Fuel tanks with a capacity of 1,200 gallons allow a cruising radius of 1,800 miles at a speed of 8 miles per hour.

A chain locker is arranged in the forepeak, entered by a small hatch. Next aft is the tank compartment, followed by the forward cabin. The steering wheel, compass and binnacle are forward in this cabin, while side transom seats are fitted with lockers. Entrance steps are placed on the port and starboard sides. On the port side is the toilet room; on the starboard side the galley, equipped with a kerosene (paraffin) stove, sink, dish rack, drainboard, lockers, etc.

The after cabin includes transom berths on either side and lockers. A dresser is installed in the after end with spring cushion seats on either side. This cabin is fitted



Shallow Draft Launch Built for Exploration of Brazilian River

with two large lockers, gun racks, etc. The bath room is located on the port side forward. Under the after deck a second fuel tank is arranged. Following this is a locker space for the stowage of miscellaneous gear, stores, etc. This compartment is made accessible by two 18-inch hatches. Towing bitts are located on the port and starboard sides of the deck.

Awnings, supported by galvanized iron stanchions and spruce spreaders, cover the forward and after decks, and hinged copper screens, arranged to swing inboard, enclose all openings.

The launch made a successful trial run on the Hudson river before her acceptance by Dr. Rice. Later she was dismantled for shipment to South America.

War-Blinded Soldiers Find Work in Shipyards

While endeavoring to find sufficient help in order to fill his war contracts with the United States Government, it occurred to F. J. Luebbert, head of a tent manufacturing concern, that if the blind were capable of becoming adept at basket weaving, the same principles would apply to making complicated knots and splices. His offer of work to students of several institutions for the blinded in war was accepted. The result proved a complete success. By patient work, with the aid of a heavy rope over which Mr. Luebbert could guide the hands of his pupils, the workers were able at the end of a week to make the Matthew Walker knot with ease.

Mr. Luebbert has suggested that these people could be used by the United States Shipping Board in making rigging for the new merchant marine fleet which we are constructing, since there is much work in rigging lofts which they could do as expertly as a sound worker.

* It is to be observed that, although the figures assumed for the prices of coal and crude oil may be different in different parts of the world, their ratio is nearly constant; also the freight market always varies with tonnage requirements, consequently the profit that a shipowner can expect from his ship varies also. For these reasons, whatever the steady peace prices may become, the profit calculation will not lose its value.

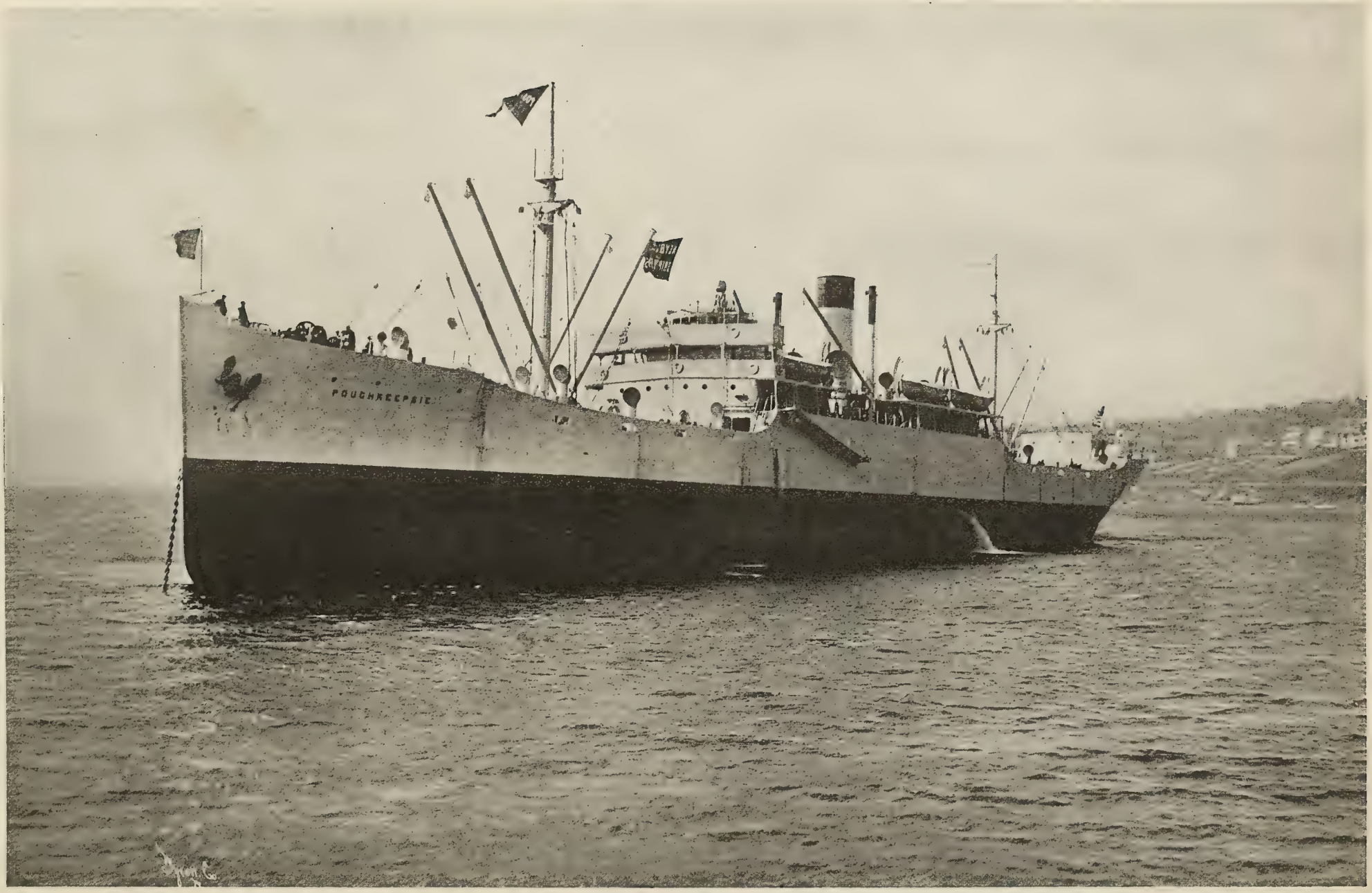


Fig. 1.—S. S. *Poughkeepsie*, 8,800-Ton Deadweight Cargo Vessel Built by Newburgh Shipyards, Inc., Newburgh, N. Y.

S. S. Poughkeepsie, Standard 8,800-Ton Deadweight Cargo Vessel Built by Newburgh Shipyards, Inc.

Two-Deck, Single-Screw Steamship Fitted with Watertube Boilers and Geared Tnrbines—Arranged for Both Coal and Oil Fuel

THE standard type of cargo vessel now being built by the Newburgh Shipyards, Inc., Newburgh, N. Y., for the United States Shipping Board Emergency Fleet Corporation is a single-screw steamship of 8,822 tons deadweight. The vessel, which is of the two-deck, poop, bridge and forecastle type, is built on the transverse system of framing with wide-spaced hold stanchions on the centerline of the ship supporting deep transverse belt beams, to which are connected two deep longitudinal deck girders. This construction leaves the holds remarkably clear for the storage of cargo.

The principal dimensions of the vessel are as follows:

Length overall	417 feet 10 inches
Length between perpendiculars	401 feet
Breadth molded	54 feet
Depth molded to upper deck	32 feet 10 inches
Distance between upper deck and second deck	9 feet
Distance between upper deck and bridge deck	8 feet 3 inches
Depth to double bottom	44 inches
Rise of floor	6 inches
Draft, Lloyd's summer freeboard	25 feet 6 inches
Deadweight on above draft	8,822 tons
Shaft horsepower (approximate)	3,000
Sea speed, loaded	10½ knots

The vessel has one smokestack and two steel masts. The foremast carries four wooden 5-ton booms and one steel 30-ton boom. The main mast carries four wooden 5-ton booms. Two 5-ton booms are mounted on king posts for handling cargo through the amidship hatch. These booms serve five cargo hatches, four of which are 29 feet 3 inches long by 20 feet wide, and one 18 feet long by 20 feet wide. The cargo is handled by eight 9-inch by 9-inch winches of the double-cylinder single-drum type, with single-winch heads, and two winches of similar type with double-winch heads. The winches are arranged four at each mast on the upper deck and two on the bridge deck.

Hull Construction

A double bottom of the cellular type, 44 inches in depth at the centerline, extends throughout the vessel. In addition to a watertight center keelson, the double bottom is further divided into six transverse compartments and has a capacity of 1,077 tons of fuel oil in five transverse tanks and 141 tons of fresh water in one transverse tank.

Seven transverse watertight bulkheads divide the vessel into five cargo holds and machinery spaces. Hold No. 1 is 65 feet 3 inches long; hold No. 2, 60 feet 9 inches; hold No. 3, 45 feet with machinery space of 51 feet 9 inches; hold No. 4 is 63 feet, and hold No. 5 is 72 feet. The bridge enclosure, which is 123 feet long, is arranged for carrying either coal or cargo.

Cargo battens of 6-inch by 2-inch pine are fitted in all lower cargo holds, 'tween deck cargo holds and in the bridge enclosure.

Fuel Bunkers

In addition to the fuel oil carried in the double bottom, the fore peak tank is also arranged for carrying 120 tons of fuel oil, which with the settling tanks in the engine room gives a total fuel oil capacity of 1,260 tons.

When the vessel is arranged for burning coal, No. 3 hold is utilized as a coal bunker, as are also the 'tween deck spaces alongside of the machinery, making the total available coal capacity 1,846 tons.

Crew Accommodations

Accommodations for officers are arranged in two steel deck houses on the bridge deck. The forward house contains accommodations for the captain, supercargo and hospital, navigating officers, radio room and saloon, with the usual pilot house and chart room superposed thereon. The after house contains accommodations for the engineering officers, water tenders and oilers. The galley is arranged at the after end of the house.

Quarters for the firemen, seamen, cadets and mess boys, with the necessary toilet accommodations, are arranged within the poop enclosure. On the poop deck is a steel deck house containing separate dining rooms for the firemen, seamen and cadets, and cabins for carpenter, boatswain, storekeeper, deck engineer and cook's mate. In the forecastle is arranged boatswain's stores, cook's stores and the carpenter's work shop. At the after end of the bridge enclosure are located two tanks containing 26 tons of drinking water, an ice machine room with a one-ton Frick ammonia machine, insulated cold room and meat room for the ship's complement.

Propelling Machinery

The main propelling machinery, located midships, consists of a cross-compound high- and low-pressure Westinghouse turbine running at 3,600 revolutions per minute and driving the line shaft at 90 revolutions per minute through a set of floating frame, double-reduction helical gears. When the turbine is supplied with steam at 185 pounds per square inch gage pressure, with 75 degrees superheat and under a vacuum of 28 inches of mercury (referred to a 30-inch barometer), it will develop 3,000 shaft horsepower at 90 revolutions per minute, consuming 11.25 pounds of steam per shaft horsepower hour.

The high-pressure ahead turbine consists of a combination of two rows of Curtis blading and fourteen rows of Parsons blading; the low-pressure ahead turbine has ten rows of Parsons blading. Within the casings of both high- and low-pressure ahead turbines are located two rows of Curtis astern blades, which operate at 60 percent of the power of the ahead blades when the same amount of steam is used under throttle and condenser pressures mentioned above.

The thrust bearing of the Kingsbury type is located at the forward end of the gear case. The propeller is of the cast iron built-up type, 17 feet in diameter with a 14-foot pitch.

The engine room auxiliaries include a main condenser with 4,000 square feet of cooling surface, supplied with cooling water by a 4,000-gallon circulating pump driven by a 52-brake-horsepower steam turbine through reduc-

tion gears from 6,900 revolutions per minute to 575 revolutions per minute. Two turbine-driven condensate pumps deliver the condensate from the condenser to the feed and filter tank. A LeBlanc ejector removes the air from the condenser. The following service pumps are included in the auxiliary apparatus:

PUMPS—TYPE AND SIZE

Two main and auxiliary vertical simplex feed pumps, 12 inches by 8 inches by 24 inches.

One vertical duplex evaporator feed pump, 4½ inches by 4 inches by 4 inches.

Two horizontal duplex fuel oil service pumps, 5¼ inches by 3½ inches by 5 inches.

One vertical duplex engine room bilge pump, 6 inches by 5¾ inches by 6 inches.

One horizontal simplex air and circulating pump for auxiliary condenser, 10 inches by 12 inches by 12 inches by 12 inches.

Two horizontal duplex lubricating oil pumps, 7½ inches by 7½ inches by 10 inches.

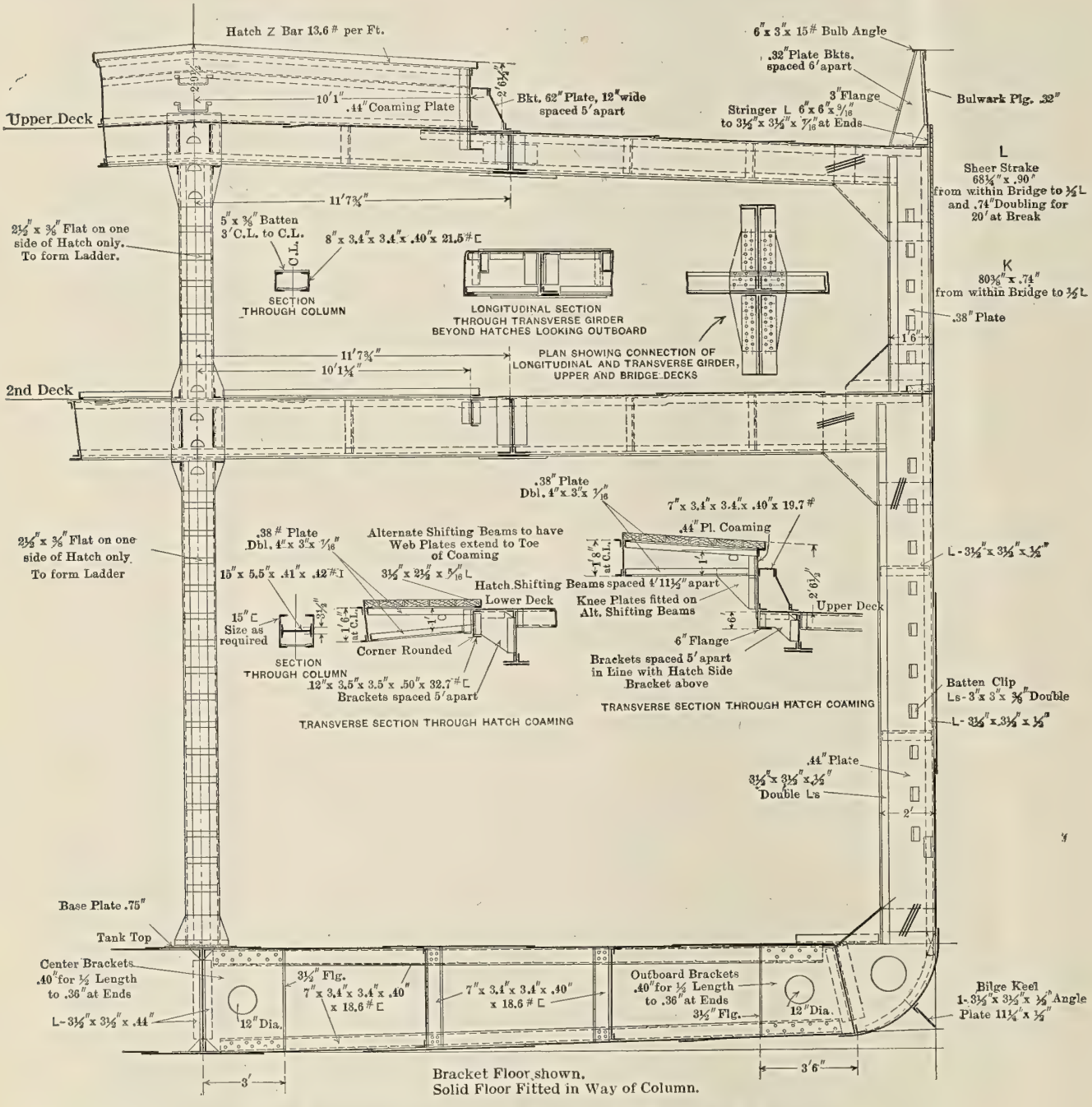


Fig. 2.—Section at Forward and After Ends of Bridge, S. S. *Poughkeepsie*

One vertical duplex ballast pump, 10 inches by 12 inches by 12 inches.

One vertical duplex fire and bilge pump, 10 inches by 8½ inches by 12 inches.

One horizontal duplex fuel oil transfer pump, 7½ inches by 7½ inches by 10 inches.

One horizontal duplex sanitary pump, 6 inches by 5¾ inches by 6 inches.

One horizontal duplex fresh water pump, 4½ inches by 3¾ inches by 4 inches.

One horizontal duplex lubricating oil cooler circulating pump, 7½ inches by 7½ inches by 10 inches.

One motor-driven centrifugal drinking water circulating pump with a capacity of 10 gallons per minute.

The engine room is also equipped with one evaporator, evaporating 25 tons per 24 hours, a feed water heater capable of heating 40,000 pounds of water from 80 degrees to 212 degrees Fahrenheit at a back pressure of 5 pounds gage, a feed and filter tank, an inspection tank, and an

S. S. POUGHKEEPSIE; STANDARD 8,800-TON DEADWEIGHT CARGO STEAMSHIP

Built by Newburgh Shipyards, Inc., Newburgh, N. Y.

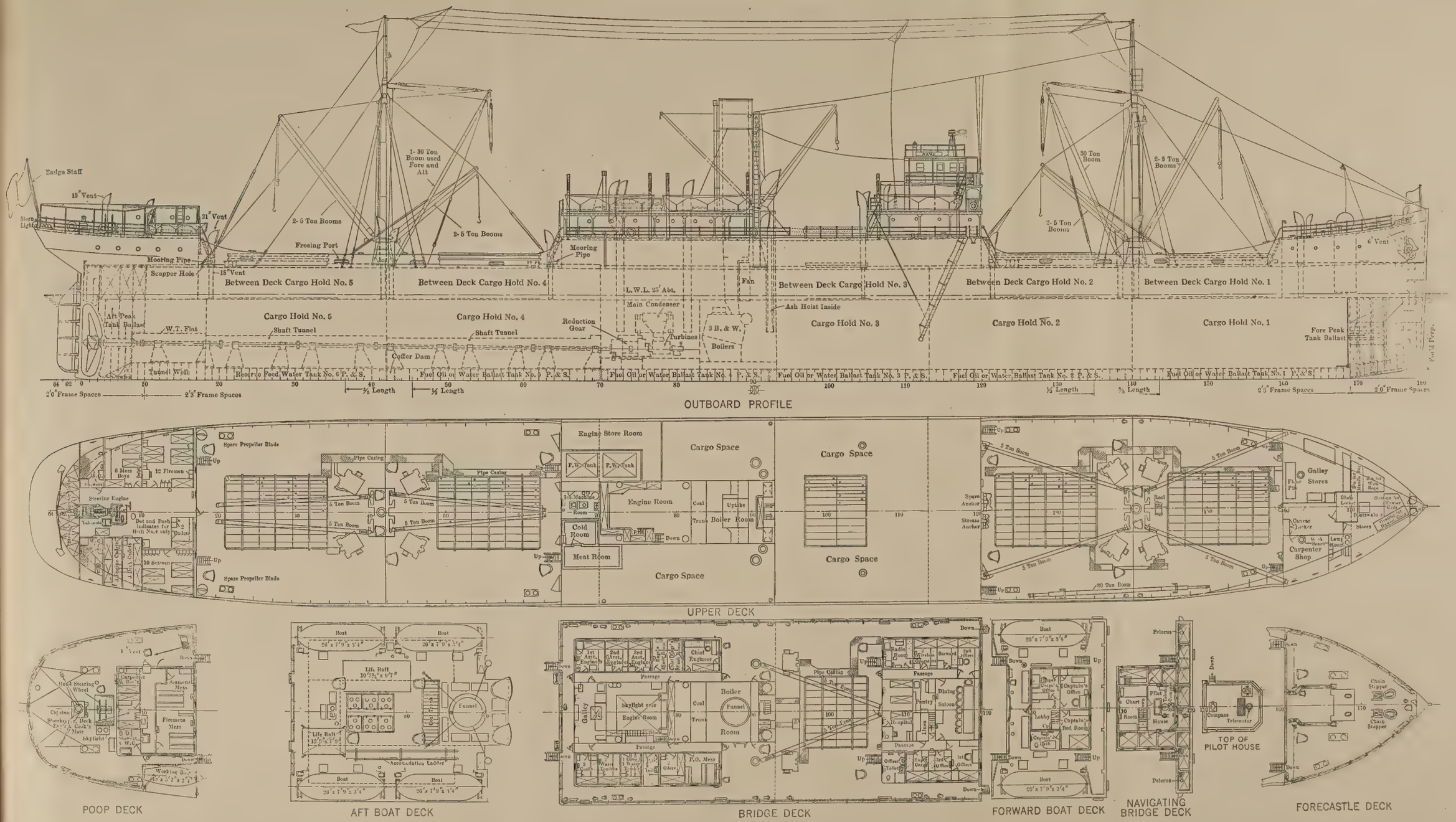
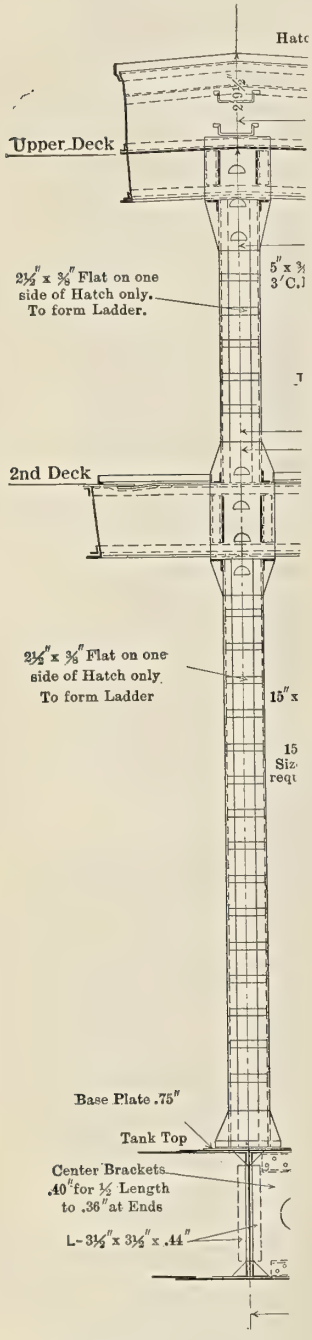


Fig. 3.—Profile and Deck Plans

tion gears from 6,900 revolu
tions per minute. Two tur
deliver the condensate from
filter tank. A LeBlanc eje
condenser. The following
the auxiliary apparatus:

PUMPS—T

Two main and auxiliary
inches by 8 inches by 24 inch



One vertical duplex ball
12 inches.

One vertical duplex fir
inches by 12 inches.

One horizontal duplex f
7½ inches by 10 inches.

One horizontal duplex
inches by 6 inches.

One horizontal duplex
inches by 4 inches.

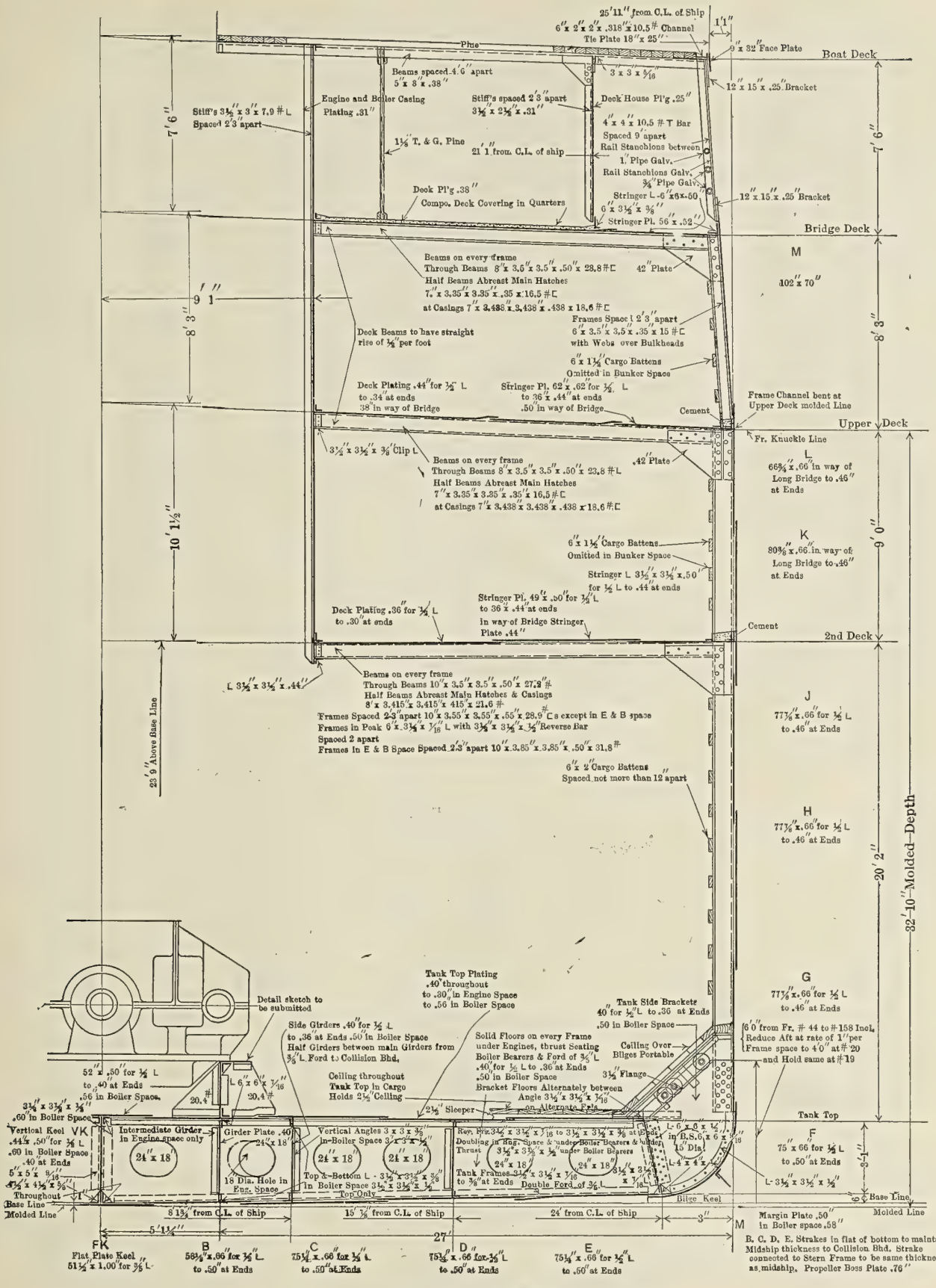


Fig. 4.—Midship Section, S. S. *Poughkeepsie*

auxiliary condenser with 800 square feet of cooling surface.

The electric power plant consists of two 12½-kilowatt, 125-volt turbine driven direct-current generators running at 4,000 revolutions per minute and delivering current to all lamps, lights, telemotors, wireless apparatus and motors.

The lubricating oil for the turbines and reduction gear is pumped from a drain tank to a 400-gallon filter and gravity tank after passing through one of two oil coolers, with cooling surfaces of 300 square feet each and an oil

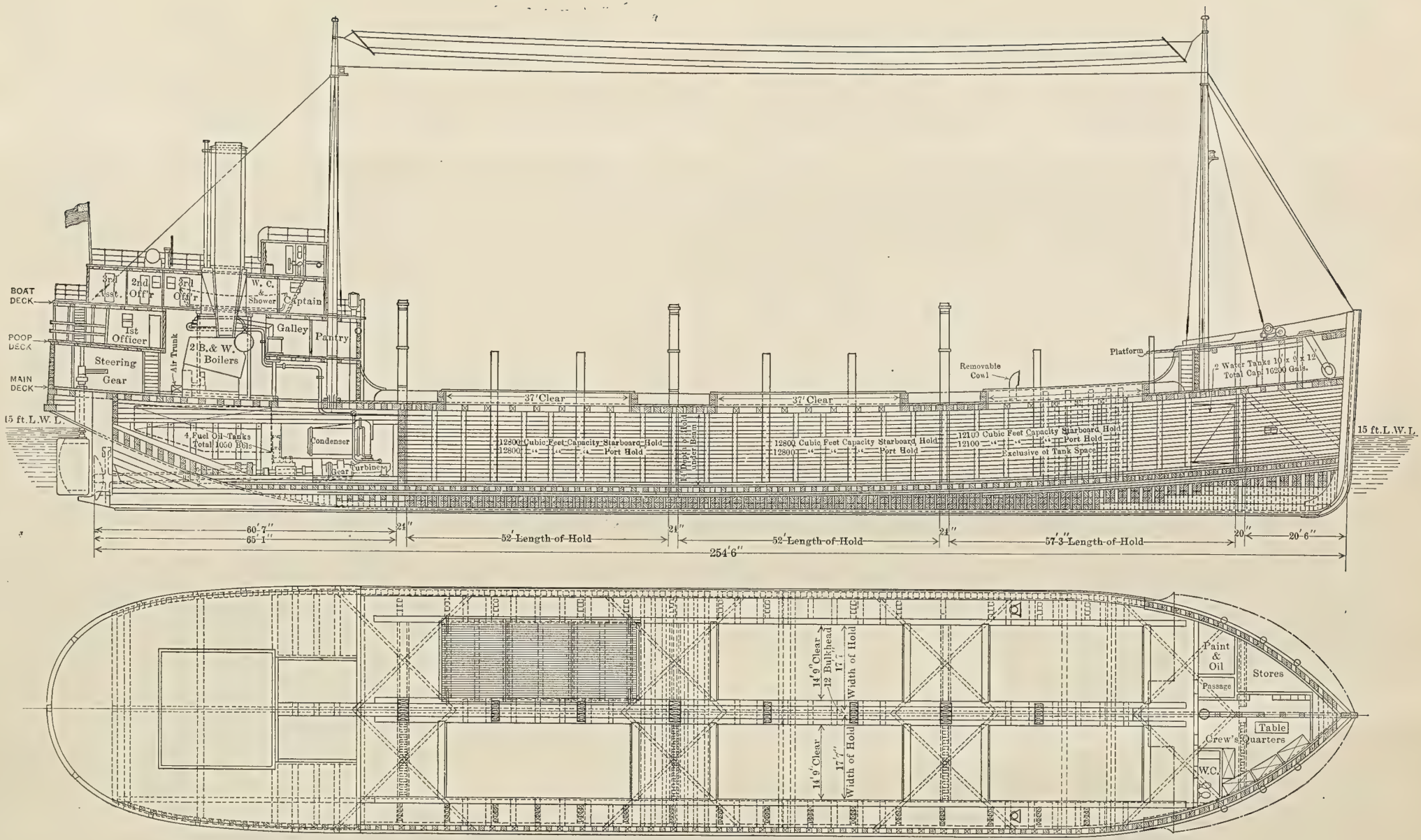


Fig. 1.—Inboard Profile and Hold Plan of Wooden Cargo Steamer *Johanna Smith*, Designed by Edward S. Hough, Consulting Engineer, San Francisco, Cal.

strainer. From the filter and gravity tank the oil passes by gravity to the turbine, reduction gear and circulating pump and thence back to the drain tank.

Boilers

Three single-drum Babcock & Wilcox watertube boilers with heating surfaces of 2,900 square feet each and carrying a pressure 200 pounds per square inch are installed. A superheater is arranged in the first pass of each boiler, giving the steam a superheat of 75 degrees. The boilers are equipped with a system of induced draft, which consists of two 86-inch steel plate fans in the uptakes, which are directly connected to two vertical direct-acting engines. The uptakes are so arranged and controlled by a system of dampers that natural draft may be substituted for induced draft.

The boilers are oil-fired, with provision made for using coal when economy so demands. Each boiler is fitted with five spray oil burners. The oil, which is stored in the inner bottom tanks, is pumped into two 8,000-gallon settling tanks situated on the port and starboard sides aft of the engine room. From this point two fuel oil service pumps deliver it to the burners through one of two oil heaters and the duplex strainer.

Steering Gear

The vessel is steered by a 9-inch by 9-inch double-cylinder screw gear having a right- and left-hand screw, controlled at the steering engine by a hand wheel. The steam valves of the engine under normal conditions are operated by an electric telemotor, with steering stations in the pilot house and on top of the pilot house. Two large wheels are located on the poop deck just aft of the house for steering the vessel by hand, in addition to which there is an emergency steering gear whereby the rudder may be operated from the after capstan.

CARGO CAPACITY

A complete tabulation of the capacity of holds and tanks is as follows:

	Grain, Cubic Feet	Bales, Cubic Feet
Hold No. 1	49,768	45,768
Hold No. 2	64,014	59,734
Hold No. 3	46,840	43,536
Hold No. 4	63,520	59,152
Hold No. 5	43,760	40,000
'Tween deck, hold No. 1	23,248	21,184
'Tween deck, hold No. 2	31,383	28,595
'Tween deck, hold No. 3	23,220	21,024
'Tween deck, hold No. 4	32,208	29,312
'Tween deck, hold No. 5	33,778	30,610
'Tween deck, side bunker	16,040	13,920
Bridge space	26,265	25,513
Bridge side bunker	15,296	13,064
Hatch No. 1	1,439	1,355
Hatch No. 2	1,439	1,355
Hatch No. 3	223	210
Hatch No. 4	1,439	1,355
Hatch No. 5	1,439	1,355
Bridge hatch B. H.	886	834
Total available cargo capacity	476,205	437,876
Cargo capacity, excluding hold No. 3, 'tween deck, side bunker and bridge side bunker	398,029	367,356

CAPACITY OF FUEL SPACES

	Cubic Feet	Tons Oil at 38 Cubic Feet	Tons Coal at 43 Cubic Feet
Hold No. 3	46,840	.....	1,089.3
'Tween deck side bunker	16,040	.....	373.0
Bridge side bunker	15,296	.....	355.7
Coal chutes	1,200	.....	27.9
Double-bottom tank No. 1	6,728	177.1	.....
Double-bottom tank No. 2	9,680	254.7	.....
Double-bottom tank No. 3	7,170	188.7	.....
Double-bottom tank No. 4	7,859	206.8	.....
Double-bottom tank No. 5	9,513	250.3	.....
Settling tanks	2,371	62.4	.....
Fore-peak tank	4,207	120.2	.....
Total		1,260.2	1,845.9

SPACES AVAILABLE FOR WATER BALLAST

	Cubic Feet	Tons Salt Water
Fore-peak tank	4,207	120.2
Aft-peak tank	5,020	143.4
Double-bottom tank No. 1	6,728	192.2
Double-bottom tank No. 2	9,680	276.6
Double-bottom tank No. 3	7,170	204.9
Double-bottom tank No. 4	7,859	224.5
Double-bottom tank No. 5	9,513	271.8
Double-bottom tank No. 6	4,932	140.9
Total	55,109	1,574.5

FEED-WATER CAPACITY

	Cubic Feet	Tons Fresh Water
Double-bottom tank No. 6	4,932	137.0

FRESH-WATER CAPACITY

	Gallons	Tons
Drinking water	6,600	24.60
Daily supply tanks	300	1.11
After-peak tank	32,248	120.2
Total	39,148	145.91

The anchor chain is 2¼-inch stud link cable operated by a 10-inch by 10-inch spur-geared windlass located on the forecastle deck.

Hough Type Wooden Ships Prove Successful

THE successful adoption of certain soft wood construction to vessels of moderate size has been demonstrated in the case of two ships designed by Edward S. Hough, consulting engineer, San Francisco, and built on the Pacific Coast. A typical construction is the *Johanna Smith,* a vessel used efficiently as a lumber carrier. When without cargo, the holds are used as deep tanks, and in months of service no weak points have developed from carrying loose water ballast in them. One of the greatest points of strength in the hull is the double bottom arrangement, which combines lightness with great strength. The ships have proved very steady in a seaway.

The *Johanna Smith* was built to the following specifications:

Length overall	268 feet
Length between perpendiculars	256 feet
Molded beam	49 feet
Beam over planking	49 feet 11 inches
Molded depth	20 feet
Deadrise	3 feet

The cargo space is divided into six holds by two continuous longitudinal wing bulkheads, four transverse and one centerline bulkhead. These holds are about 14 feet clear depth. Four hatches 37 feet by 14½ feet, and two hatches 32 feet by 14½ feet, give ready access to the cargo spaces.

The propelling machinery, boilers and auxiliaries are all aft. Two oil-burning Babcock & Wilcox watertube boilers with superheaters supply steam at 225 pounds pressure to two De Laval turbines, each developing 750 brake horsepower. The turbines are geared independently to twin screws. The boilers are installed on the main deck, while the turbines, condenser, air pump, simplex feed pumps, centrifugal circulating pump and fuel oil tanks are in the hold. A simple mechanical draft arrangement preheats the air by passing it under the ash pit.

The auxiliary equipment includes two direct-coupled 10-kilowatt steam-driven generators and a steam-driven ice machine, refrigerating a two-section cooling room. The steering gear is of the steam quadrant type, with hand-operating gear on deck directly overhead. Two repeating telegraphs are cross-connected from the bridge to the engine room.

The deck machinery includes two steam capstans on the forecastle head, two on the poop deck and one steam-driven anchor windlass.

The officers' quarters are arranged on the poop deck and above, while the oilers, firemen and waiters are housed aft on the main deck. The deck crew is quartered in a raised forecastle forward.

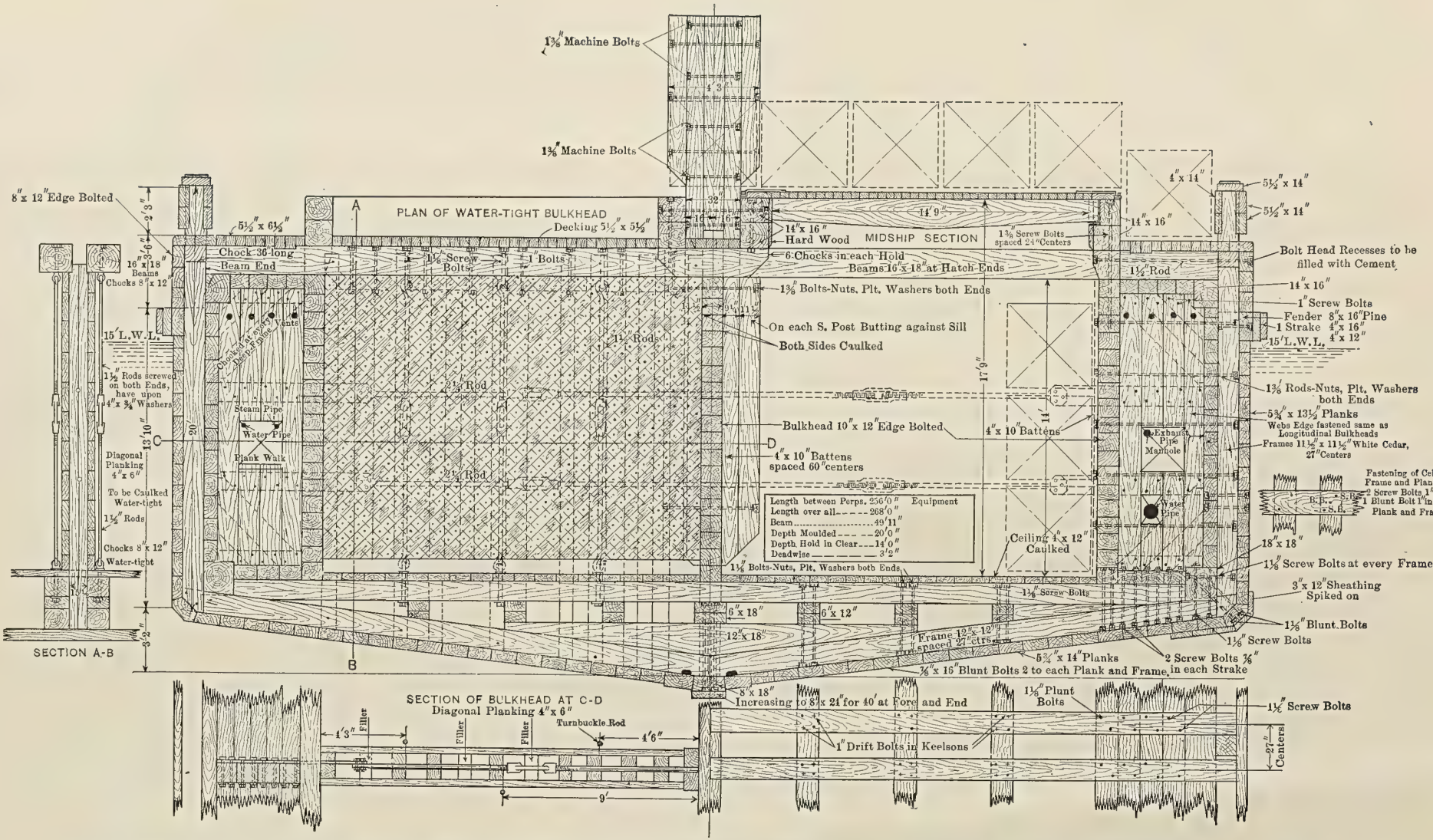


Fig. 2.—Midship Section and Sections Through Bulkhead of Wooden Cargo Steamer *Johanna Smith*, Designed by Edward S. Hough, Consulting Engineer, San Francisco, Cal.



Fig. 1.—The Steamship *Curaca* Practically Split in Half

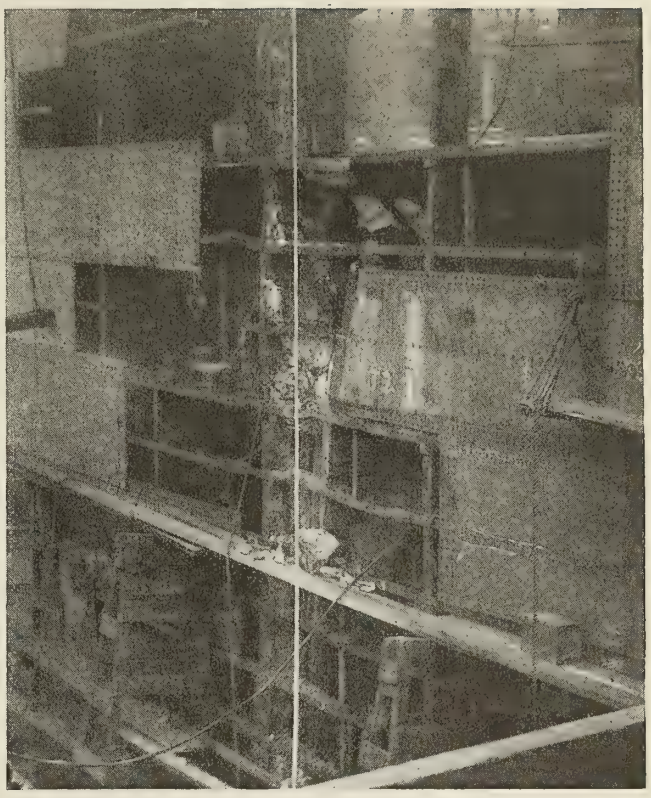


Fig. 2.—The Steamship *Curaca* 24 Hours After She Was in Dry Dock

The ship has a speed of 9½ knots under full load, and in this condition has a mean draft of 17 feet. With suitable wharf-crane equipment, it is possible to either load or unload a cargo of 1,400,000 feet of lumber in ten hours.

Similar type ships have given satisfactory service throughout the war period, carrying general cargo.

Unique Engineering Feat

THE repair of the steamship *Curaca* is one of the strangest ever attempted in American yards. The work was carried out by the Robin's Drydock and Repair Company, Brooklyn, N. Y.

The *Curaca* was sunk during the explosion in Halifax Harbor. Her superstructure was blown away, and she buckled at about the mid-length to such an extent that when refloated the draft at this place was 16 feet 2 inches, while the draft at the bow was 7 feet and at the stern 9 feet 8 inches, showing that the vessel was forced up 9 feet 2 inches from the base line at the bow, while the stern was forced up 6 feet 6 inches.

In this condition the vessel was raised, temporarily repaired and brought back to New York under her own steam, and the work of straightening and repairing commenced on April 25, 1919.

The big problem here was to restore the vessel to an even keel. On a preliminary survey this seemed to be impossible. Further examination was made, and finally a plan was outlined which subsequently proved successful.

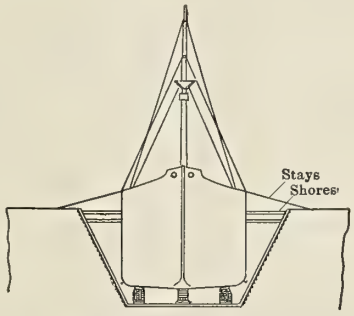


Fig. 4.—Section Through Drydock

The report of the work is of interest, and reads as follows:

Keel blocks were set solid for a length of thirty-six feet, as it had not been determined exactly where the buckle was located. On April 25, the vessel was warped into number 2 graving dock, at the Robin's plant, placed

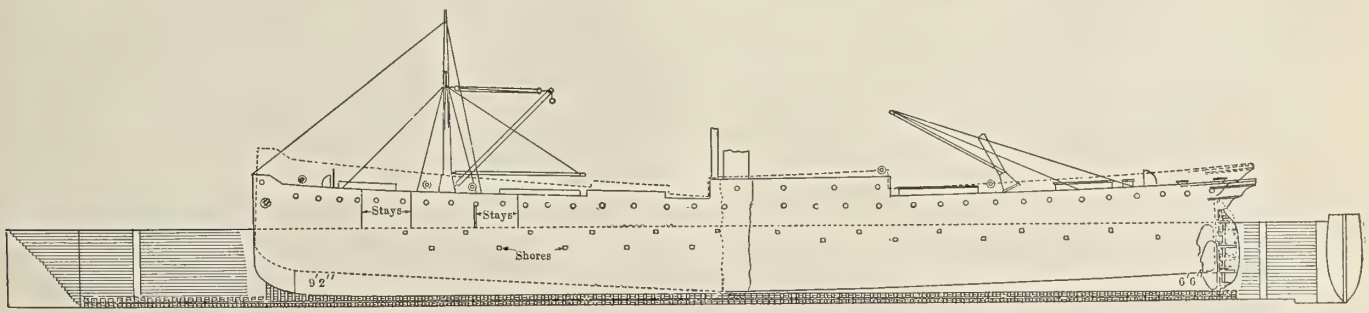


Fig. 3.—Dotted Lines Show Original Position of the *Curaca* in Dry Dock Before Water Was Pumped Out and Sides of Vessel Cut Apart

over the blocks and plumbed up. Shores from each side of the dock were then set in place against the sides of the vessel. Wire hawsers were extended from each side of the deck and made fast ashore, so that there would be no danger of either the forward or after section listing, if a break should result at the buckle point before the straightening of the vessel was completed.

The dock pumps were then started. As soon as the buckled area of the keel touched the blocks the pumps were stopped and an examination made to see that the vessel was perfectly upright and over the blocks. The sides of the vessel were then gradually cut at the buckle from the deck to the waterline on both sides. The pumps were again started, and as the dock was slowly freed from water the cutting was continued about 6 inches at a time.

Close observation showed that as the cutting of the plates and the pumping out of the water progressed the ends of the *Curaca* dropped gradually, being without the support of the blocks. During this operation frequent inspections were made to determine that both the forward and after sections were upright, and the hull had not twisted and that no structural change had resulted. When the dock had been pumped dry the entire keel of the *Curaca* rested on the blocks.

This operation was begun at 7:30 A. M. and was successfully completed at 3 P. M. the same day.

The bottom plating around the buckle had fractured, due, probably, to the vessel having worked at this point. The bottom of the *Curaca* was also damaged in the explosion to such an extent that 54 of her bottom plates needed to be repaired and renewed.



Russian Railroad Equipment Stored in Seattle Railway Yards

American Vessels Carry 70,000 Tons of Russian Railroad Equipment

THE trans-Pacific steamships of the United States Shipping Board are now transporting to Vladivotock, Siberia, for the Russian Mission of Ways of Communication, seventy thousand tons of railroad rolling stock, which have previously been stored on a twenty-acre stretch of land near the railroad yards south of Seattle, Wash., and barred from shipment across the Pacific Ocean. The material is finally being removed as rapidly as possible, with the consent of Government authorities.

More than three years ago Czar Nicholas of Russia sent to the United States a special party of transportation and railroad experts to purchase machinery and supplies which would assist in opening a vast area in Siberia to railroad travel. The expedition purchased seventy thousand tons of railroad stock, including knock-down railroad coaches, locomotives, engines, wheels and various other railroad parts. This big supply was shipped across the continent to Seattle, where it was stored in railroad yards preparatory to being transshipped across the Pacific Ocean to the Siberian port of Vladivostock. America's entrance into the world war, however, prompted Government officials to delay shipment until additional steamships were available. Then came the internal strife in Russia, the overthrow of the Czar, the victory of the Bolshevik armies and the turmoil which began to rage even as far east in the Russian Empire as Siberia.

With conditions adjusted in Siberia, a request was served on the American Government by M. Kagansky, Seattle representative of the Russian Mission of Ways of Communication, to release the railroad supplies. After investigation, the Government forwarded the first shipment of more than 8,000 tons in May, 1919, on the steamship *West Helix*, a 9,800-ton steel vessel built in Seattle. Since that sailing several other ships have loaded the stock for Vladivostock. Probably the entire supply of 70,000 tons will have been delivered across the ocean at the end of the year.

British Admiralty Cancels Orders for 326 Vessels in Eight Months

Since the signing of the armistice the British Admiralty has cancelled orders for 326 vessels, resulting in a net saving of $200,000,000 (£42,000,000). When the armistice was concluded there were 302 war vessels and 806 auxiliaries under contract by the Admiralty. At the present time there are being completed 84 war vessels and 110 auxiliaries, mainly to replace old ships or to meet the ravages of war.



American Vessel Taking on Cargo of Russian Railroad Equipment

Uniform Cost Accounting in Shipbuilding

Plan Adopted by the Atlantic Coast Shipbuilders' Association for Uniform Methods of Cost Accounting in Steel Shipbuilding

BY J. L. JACOBS*

RETENTION of the present position of the United States in the world's shipbuilding programme makes it imperative that shipbuilders adopt methods of cost control and operating efficiency with assurance of sane and intelligent competition. Through this means the individual shipbuilders and the shipbuilding industry as a whole will not be made to suffer from quotations and production based upon inadequate or insufficient cost and production data. At the same time, opportunities will be opened for increased profits and stimulation for greater production, and lower costs should result.

The United States Shipping Board Emergency Fleet Corporation and the Atlantic Coast Shipbuilders' Association have directed the attention of shipbuilders to the importance of adequate and accurate cost finding methods as one of the mediums for increased production and lower costs in shipbuilding. The work of developing uniform methods of cost accounting which might be applied to any type of yard was undertaken by a joint committee from the Atlantic Coast Shipbuilders' Association and the United States Shipping Board Emergency Fleet Corporation with co-operation by the shipyards of the Great Lakes district. Since the approval by the association and the Emergency Fleet Corporation of the general plan of uniform cost methods which is outlined herewith, another important step has been taken by the Atlantic Coast Shipbuilders' Association, which comprises all the steel shipyards on the Atlantic and Gulf coasts, in the appointment of a committee of influential executives to promulgate and put into actual effect the methods recommended.

The wisdom and advantages of uniform cost finding methods in the huge and complicated business of ship manufacture is clear in the light of shipbuilding experiences before the war. The value of current cost statistics and comparable standards of operation in shipbuilding has been realized by a few of the shipyards. Stores' control and labor distribution are quite well advanced in these shipyards, and some basis for distribution of expense has been set up.

Many shipbuilders fully recognize the value of accurate and comparable cost figures as a means of establishing standards for estimating and for comparing operation efficiencies and for providing proper bases for production costs and selling prices.

Most of the other shipyards have little of what might be termed "cost keeping," and the practices of charging labor and materials and distribution of expense to departments and to jobs are not defined and are insufficient.

In most instances the value of the cost information which is compiled is of little significance and the data obtained are not related to any standards, so that the executives have little or no conclusive basis for controlling operation and production.

Advantages Derived from Proper Cost Methods

The more important benefits to be derived from the application of properly designed cost accounting methods, when applied uniformly in the various shipyards, briefly stated are as follows:

1. Reliable guide and basis for estimating prospective business.
2. Complete costs of specific articles and indicator of profitable and unprofitable production and service activities.
3. Gage of the value, efficiency and wastes of workers, machines, methods, operations and plants.
4. Uniform terminology enabling comparisons of progress and efficiency of production between units in shipyards and between groups of shipyards.
5. Supplementing of general accounts of shipyards with cost accounts and proving of accuracy of costs and adequacy of methods through general bookkeeping system.
6. Ease with which cost and progress figures may be arranged in a simple, tale-telling manner.
7. Control of operation and production standards through current periodic cost figures.
8. Visualization of business conditions by executives through logical arrangement of figures.
9. Insurance against unintelligent competition and unprofitable undertakings.
10. Current reports for comparing of major cost items with standards, which are predetermined, and measuring and increasing operating efficiency.
11. Co-operation and friendly competition resulting from cost comparisons.

Major Considerations in Devising Uniform Cost Methods

The primary object in the preparation of the standardized cost finding methods has been to develop the basic principles, definitions of cost elements and the nature of cost statistics applicable and useful to the various shipyards.

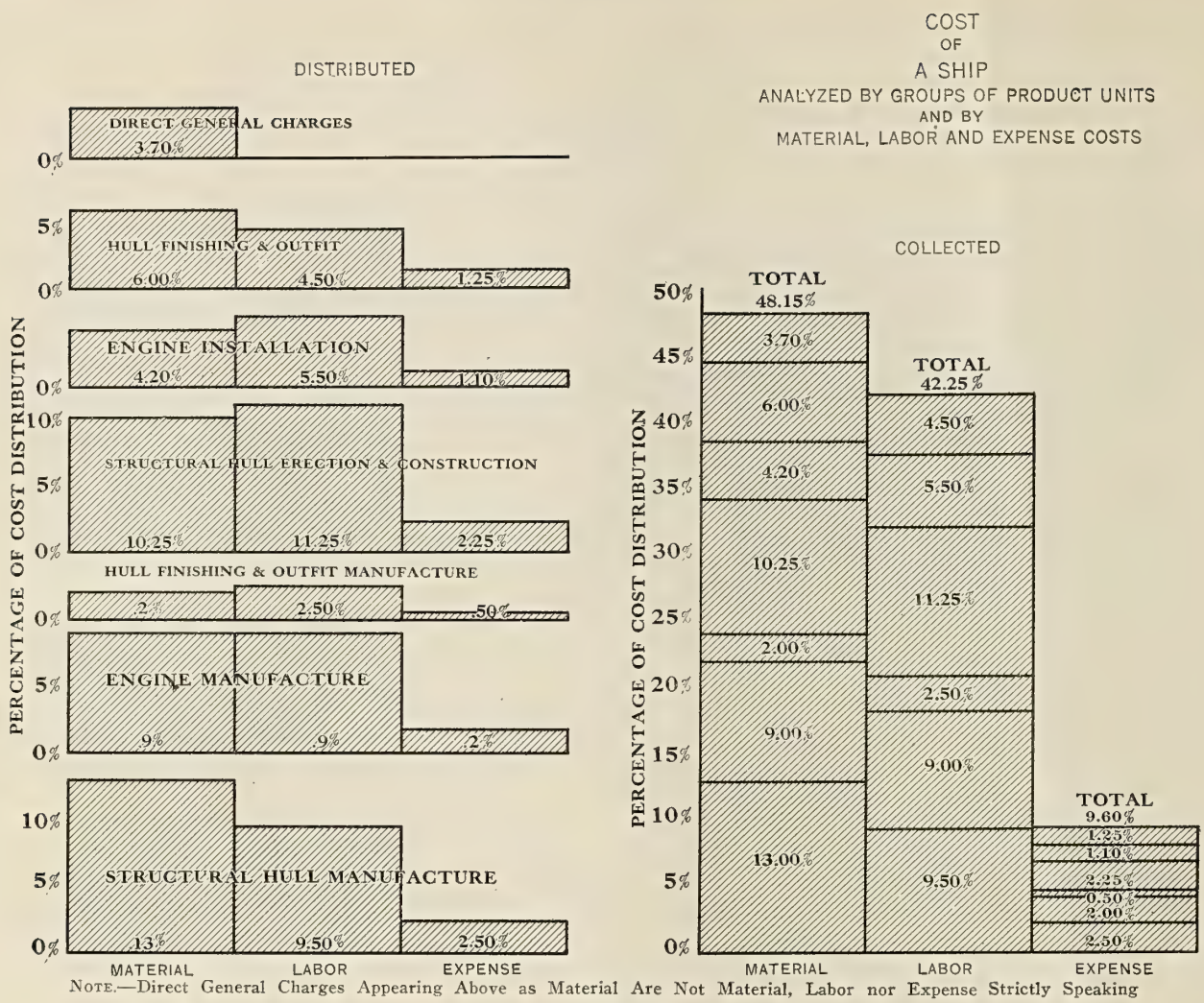
To establish uniformity in cost accounting, it was essential that standard methods be first established in the controlling items and divisions. These are of particular importance from the point of view of shipbuilding executives, who will be enabled currently to visualize production and operation conditions and to compare costs with standards in their shipyards, as well as with other shipyards.

The preparation of the plan of uniform cost finding methods was preceded by thorough examination of prevailing practices and methods and of the organization of some twenty-five shipbuilding companies (representing over sixty shipyards).

Examinations of the shipyard organizations, of the physical plants, and of the activities in the shipyards, bring out clearly the diversity and number of classes of activities and product units. At one extreme there are the shipyards which manufacture and fabricate their own hull steel and engines complete from basic raw materials and also manufacture much of the ship outfit. At the other extreme there are those shipyards which purchase complete engines, machinery, etc., as well as fabricated steel for hull, and buy much of the ship's outfit. Between these two extremes are numerous variations and modifications.

Any standardized methods of determining shipbuilding

* J. L. Jacobs & Company, industrial engineers and cost accountants, Chicago, Ill.



NOTE.—Direct General Charges Appearing Above as Material Are Not Material, Labor nor Expense Strictly Speaking

Fig. 1

costs which do not recognize the basic divisions and major differences in activities and products must of necessity be incomplete or superficial. The basic lines of distinction or classification must be so fundamental that they will be adaptable to the variations in activities and products which exist in any shipyard.

Cost methods consist essentially of the collection and arranging and applying of material, labor and expense charges to job accounts or contracts in a way that will furnish adequate costs and continuous control of production and operating efficiency. The first thing, therefore, in the development of standardized cost methods is to define the plant activities and product units and departments through which it is desired to collect charges, so that such charges will at all times be confined to the same items and so that there will be no confusion in the distribution and arrangement of the charges.

Classifications of the major activities, product units and departmental divisions in the shipyards for the purpose of uniformity in ascertaining and applying costs have been drawn up in such a way as to be applicable to all shipyards. Any individual plant can use those items which are applicable and omit those items which are not applicable. Also, each yard can, where desired, develop any detail subdivisions under each of the main divisions without in any way affecting the general classifications or the purposes of the standardized plan of cost accounting.

In the analysis of the information which was collected, certain main requirements were disclosed which are essential for effective cost methods, and these are developed in the proposed plan. These points or requirements consist of the following:

(a) Accuracy.
(b) Timeliness.
(c) Uniformity of Terminology.
(d) Uniformity of Cost Classifications.
(e) Uniformity in Expense Distribution.
(f) Standard Basis for Estimates.
(g) Definite Standards of Comparison.
(h) Standard Instructions and Procedure.
(i) Control of Stores and Labor.
(j) Cost Organization.

General Methods of Cost Finding

Broadly considered, there are two general methods of ascertaining and compiling costs. One of these is generally referred to as the "process method" and consists of the gathering and compiling of costs by processes. The cost of any product unit or article is equal to the total of the direct and indirect costs and expenses incurred in the processes through which the product passes. The process method of cost accounting is particularly applicable where the product is standardized and production consists of a series of definitely measured complete processes or operations.

The other general cost finding method is referred to as the "job order method." Where this method is used, cost charges are ascertained and applied against specific product units or jobs. The "job order method" is applicable

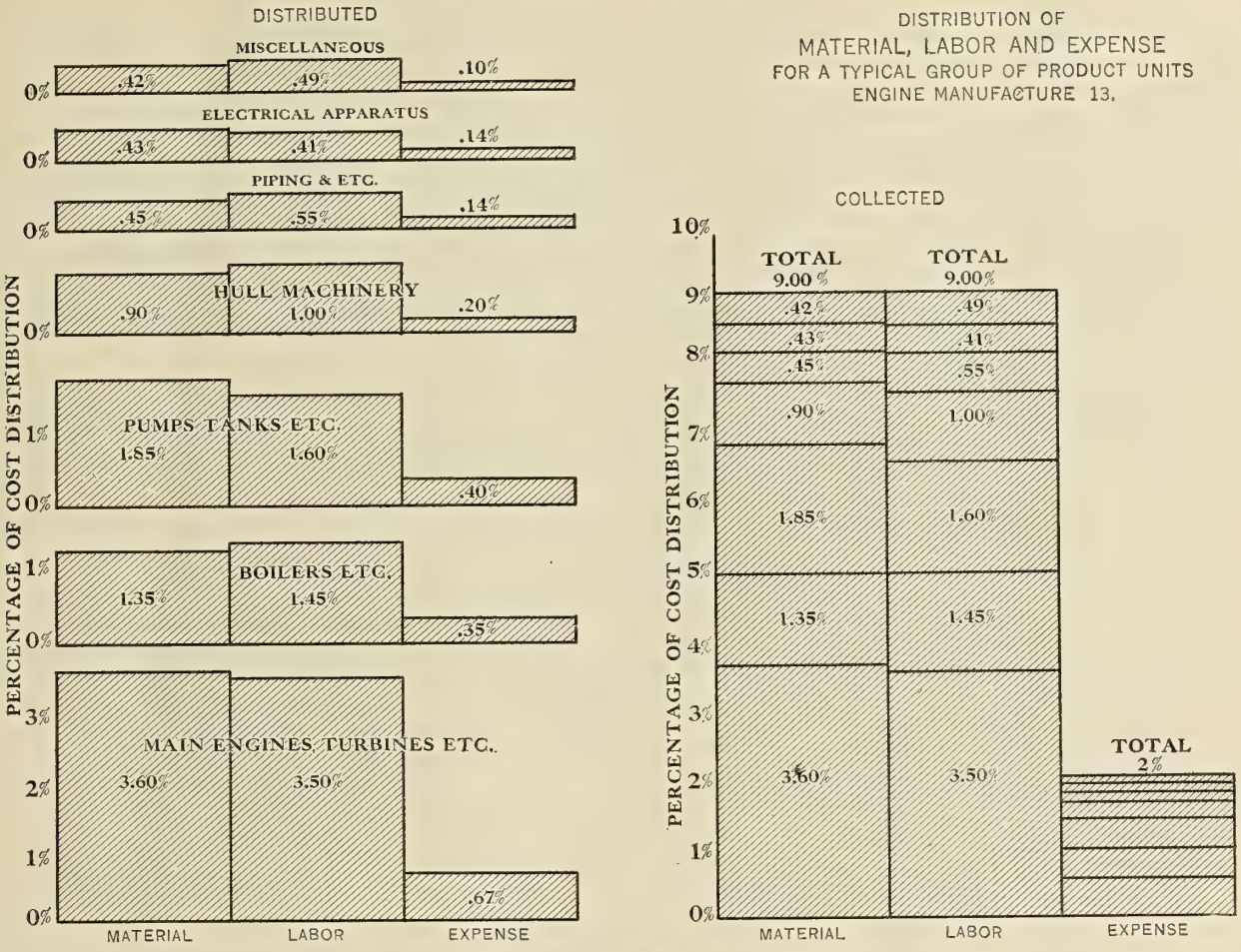


Fig. 2

where the product is not standardized, where the work varies considerably with different orders, or where production does not consist of a series of standard recurring processes.

Of the two general methods, the "job order method" is clearly the standard method which can best be applied to the various activities in the shipbuilding industry. In a general way, the job order method was the one in use at the time of the examinations in most shipyards, although there were many variations from the standard methods adopted in the uniform plan.

Classification of Shipyard Work

The main activities of shipyard work are included under a series of shipyard production orders. The classification of production orders includes all the distinct shipyard activities, and distinguishing order numbers constitute the method of identifying these different classes of work.

Each order authorizing work is given a production order number by which that job is thereafter known and distinguished from all other orders. The production or job order number will facilitate in comparing all the elements of cost, in tracing the costs which are applicable to any job, and in classifying the production work done in the shipyard.

The main series of shipyard production orders has been designed so as to be applicable to any shipyard. The series may be amplified or reduced without affecting the general plan. The production order classification and definitions of each of the main classifications are as follows:

1. *Construction Orders—Ships* are used on all orders for the production of a ship entire, including the steel hull, machinery, and finishing and outfit.
2. *Construction Orders—Ship Product Stock* are used for all orders for the production of ship materials, parts or equipment (other than by auxiliary and stock manufacture departments) where the product is to go into stock.
3. *Construction Orders—Special Contracts* are used for all special orders of ship production where only parts of the entire ship or all work of special ship construction are included.
4. *Auxiliary and Stock Manufacture Orders* are used for all orders for work by auxiliary and stock manufacture departments.
5. *Defective Work Orders* are used for all orders in connection with defective work or for correction of defects in any articles or products manufactured.
6. *Vessel Repair Orders* are used for all orders for ship repair work.
7. *Construction and Betterment Orders—Plant and Equipment* are used for all orders for new construction or betterments on plant or equipment, which improvements are permanent in nature and add to the capital investment of the plant.
8. *Repairs and Maintenance Orders—Plant and Equipment* are used for all orders on general repair and maintenance work on buildings, machinery, equipment, fixtures or tools, which work does not affect the capital investment of the plant, the

cost of which work is either charged to depreciation reserve or is a part of productive, general works or general administrative expenses.

9. *Miscellaneous Orders* are used for all production orders not included in any of the above (include material, labor and expense for others).

Ship Product Units' Classificaton and Methods

Under each class of production orders there are the product units upon which complete costs should be gathered and to which charges should be made for material, labor and expense costs. It is thus seen that the cost for any particular production order is the sum of the material, labor and expense costs of each of the product units.

Analysis of the organization and functions in shipyards, which was made for the purpose of determining the basic divisions in shipyard work, has led to the definite conclusion that the basis should not be location, i. e., a classification as between work in the shop or work in the field (yard). It is also clear that, for purposes of uniformity in methods and comparative cost figures as between shipyards, the basis of the shipyard product divisions should be more elemental than the ship parts basis, i. e., distinction between the hull, machinery and outfit.

The division, which will permit of proper standardized methods in cost finding and which is practical of application in shipbuilding is based on the functional division of shipyard work into two primary classes into which shipyard activities group themselves, namely:

1. Manufacture of Ship Parts.
2. Ship Construction and Machinery and Outfit Installation.

Manufacture of ship parts includes all work and operations involved in fabrication or machining, or other work to put raw materials or component parts into a state where such parts are ready for assembling and ship construction. This division also includes all work and operations involved in the manufacture of raw materials (except work in stock manufacture) or such component parts which become a part of engines, machinery, piping and ship outfit and other ship parts where they are ready for installation in the vessel.

Ship construction and machinery and outfit installation includes all work and operations involved in assembling and erection of steel hull, all steel work on hull, all wood work and the installation of engines, machinery and fittings outfit and finishing and the work in the delivery of the vessel to the owner.

The primary functions, (1) manufacture of ship parts and (2) ship construction and machinery and outfit installation, naturally divide themselves into subdivisions based upon divisions of hull and the parts or groups of engines, machinery, outfits, etc. Each subdivision or group in turn consists of a number of similar units of specific parts which, when assembled with other units, make up the group.

The main subdivisions of each of the primary functions are as follows:

1. Structural Hull.
2. Machinery.
3. Hull Finishing and Outfit.

The product units constitute the job accounts to which all direct charges of labor and material and the distribution of expense should be made. These job accounts or product units will thus be the basis of the outlines for cost summaries and cost estimates, as well as for the payment for work completed.

In addition to these main subdivisions, there is included under the main division of ship construction and machinery and outfit installation the group of accounts which cover the direct charges which are of a general character. These accounts consist of such expenses as insurance and classification fees, cost of staging, shoring and fairing, testing and inspection, launching and entertaining, trials and delivery, etc., as are incurred on any job or contract, and should be applied directly to the job account or contract.

The principal divisions of the ship product unit classification are therefore as follows:

1. Manufacture of Ship Parts.
   - 11. Structural Hull Manufacture.
   - 13. Machinery Manufacture.
   - 15. Hull Finishing and Outfit Manufacture.
   - 17. Auxiliary and Stock Manufacture.
2. Ship Construction and Engine and Outfit Installation.
   - 21. Structural Hull Erection and Construction.
   - 23. Machinery Installation.
   - 25. Hull Finishing and Outfit.
   - 27. Direct General Charges.

Definitions of each of these groups and subdivisions make it certain that all shipyard organizations will interpret the control divisions in a uniform way. Detail classifications are also provided under each of the main heads, but are not carried to such a point as to restrict shipbuilders in their treatment of specific items.

Departmental Classification and Expense Distribution

For purposes of proper gathering and distribution of expense or overhead, and for closer control of the elements of costs and of production, all costs should, in so far as it is possible, be gathered and applied to job accounts or product units through the respective departments. A charges and will serve as a valuable means of operating through the departments will furnish more accurate cost charges and will serve as a valuable means of operating and efficiency control.

Charges are made to job accounts for product units for labor, material and expense. The direct labor charges against the job accounts are reported through the department and the labor changes thus secured are used as a basis for distribution of expense to the various job accounts or product units. The departmental classification thus had its greatest use in connection with the distributing and compiling expense costs to the product units or job accounts.

The main divisions of the departmental classification consist of the following:

1. Productive Departments.
2. General Works Departments.
3. General Works Distributive Departments.
4. Auxiliary and Stock Manufacturing Departments.
5. General Administrative Departments.

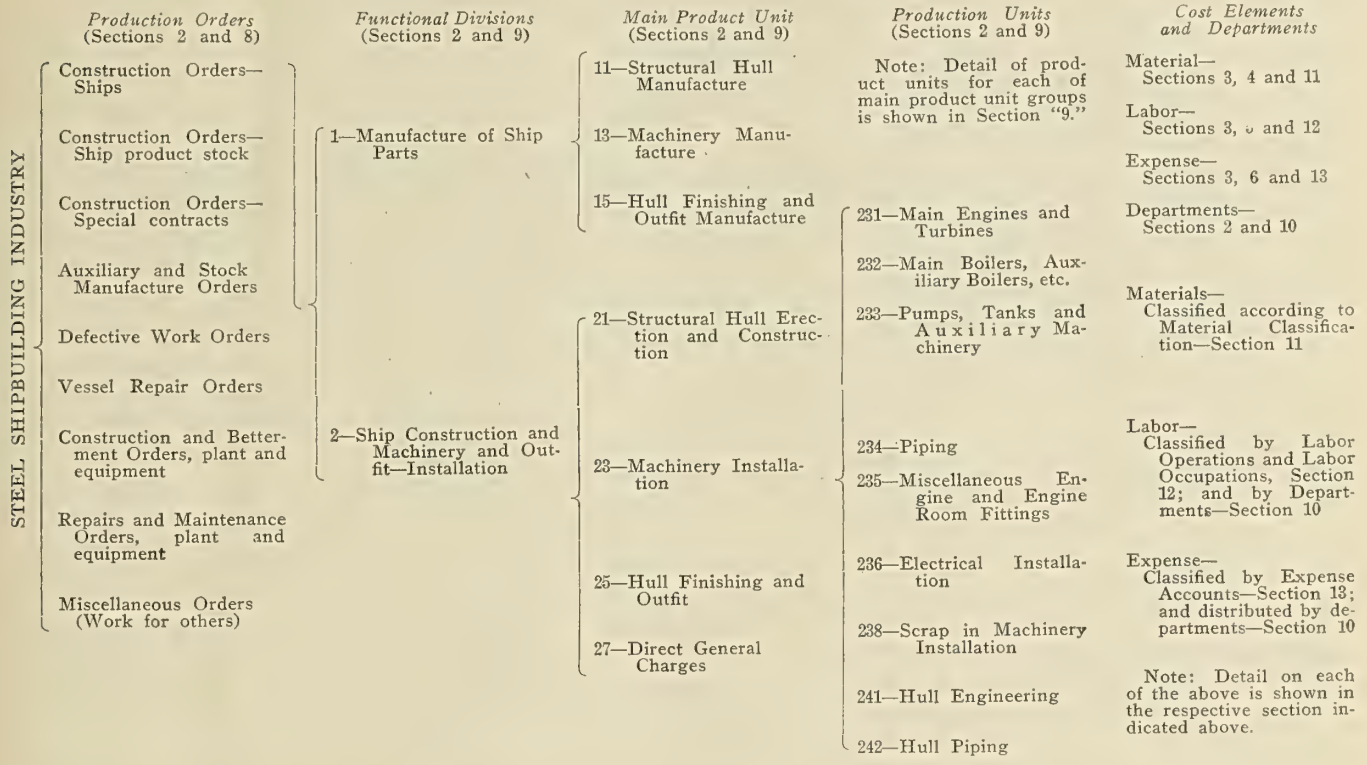
Under each of the above divisions are set out the typical departmental organizations which are ordinarily found in a shipyard. In those cases where there are more than one shipworks, each plant will be given a separate plant number or other distinguishing code designation, and this designation will be used with the departmental code designation for reporting and ascertaining costs and for proper expense distribution.

Outlines of Cost Statistics

A graphic representation of the general plan of collecting, arranging and analyzing elements of production costs as applied to steel shipyards is shown on the chart on this

GRAPHIC ILLUSTRATION OF PLAN FOR COLLECTING, ARRANGING AND ANALYZING ELEMENTS OF SHIPYARD PRODUCTION COSTS

Report and Recommendations on Uniform Methods of Cost Accounting in Shipbuilding. Compiled for Committee on Uniform Methods of Cost Accounting, Atlantic Coast Shipbuilders' Association, by J. L. Jacobs & Company, Chicago



page. This exhibit makes clear the building up of summary cost statistics for each type and class of wrok which is done in a shipyard through the series of production orders. It will be noted that costs are obtained and compiled for each of the production units through different job accounts. The cost of the main product unit group is a sum of the costs of its product units. Likewise, the cost of the production order is a sum of the cost of the main product unit groups. The cost of all direct materials, direct labor and expense are ascertained and compiled for each product unit.

In the two other exhibits (Figs. 1-2) is shown the general plan of ascertaining the cost of a ship analyzed by groups of product units and by material, labor and expense costs and the distribution of material, labor and expense for a typical group of production units.

It will be noted on these charts that the horizontal sections represent the product unit groups of a ship, such as structural hull manufacture, engine manufacture, hull finishing and outfit manufacture, structural hull erection and construction, etc., and the vertical divisions represent the cost elements of direct material, direct labor and expense. Direct material, direct labor and expense are shown for each production unit and in total.

These exhibits have been drawn for the purpose of visualizing cost analysis and distribution, and do not presume to show the actual proportions of costs found in practice.

The general methods of cost finding in steel shipbuilding are thus briefly summarized as follows:

1. Costs are ascertained and compiled for every type and class of work which is done in a shipyard through the several series of production orders.
2. Costs are obtained and compiled for each of the product units through the different job accounts. Thus the cost of a production order is the sum of the cost of the product units.
3. The cost of each product units is ascertained and compiled under the three main elements of cost, namely, direct labor and direct material charged directly to the product unit and expense, apportioned to it.
4. For purposes of compiling and proving direct charges and uniform expense cost to production and securing control over all costs, definite departmental divisions and designations are used.
5. Costs are treated with definiteness and uniformity through standard classifications of the controlling divisions.
6. Definite cost figures under each of the job accounts or product units supply standards for use in estimating and measuring production progress and operating efficiency.
7. Control of all work in process and stores through the general ledgers.

(*To be concluded.*)

Shipbuilding in Scotland

Shipyards in Scotland during the month of June launched 44 vessels aggregating 90,587 tons. Of the vessels, 38 of 83,907 gross tons were built on the Clyde, three of 4,900 gross tons on the Forth, one of 1,390 gross tons on the Tay, and two of 400 tons on the Dee. The Clyde output was the second largest among those of the months of this year. The Clyde total of 264,806 gross tons for the half-year is practically as high as the total for the corresponding period of 1914 and represents a total very well up to the average of pre-war years. Most of the vessels launched in June were large merchant steamships for private owners.

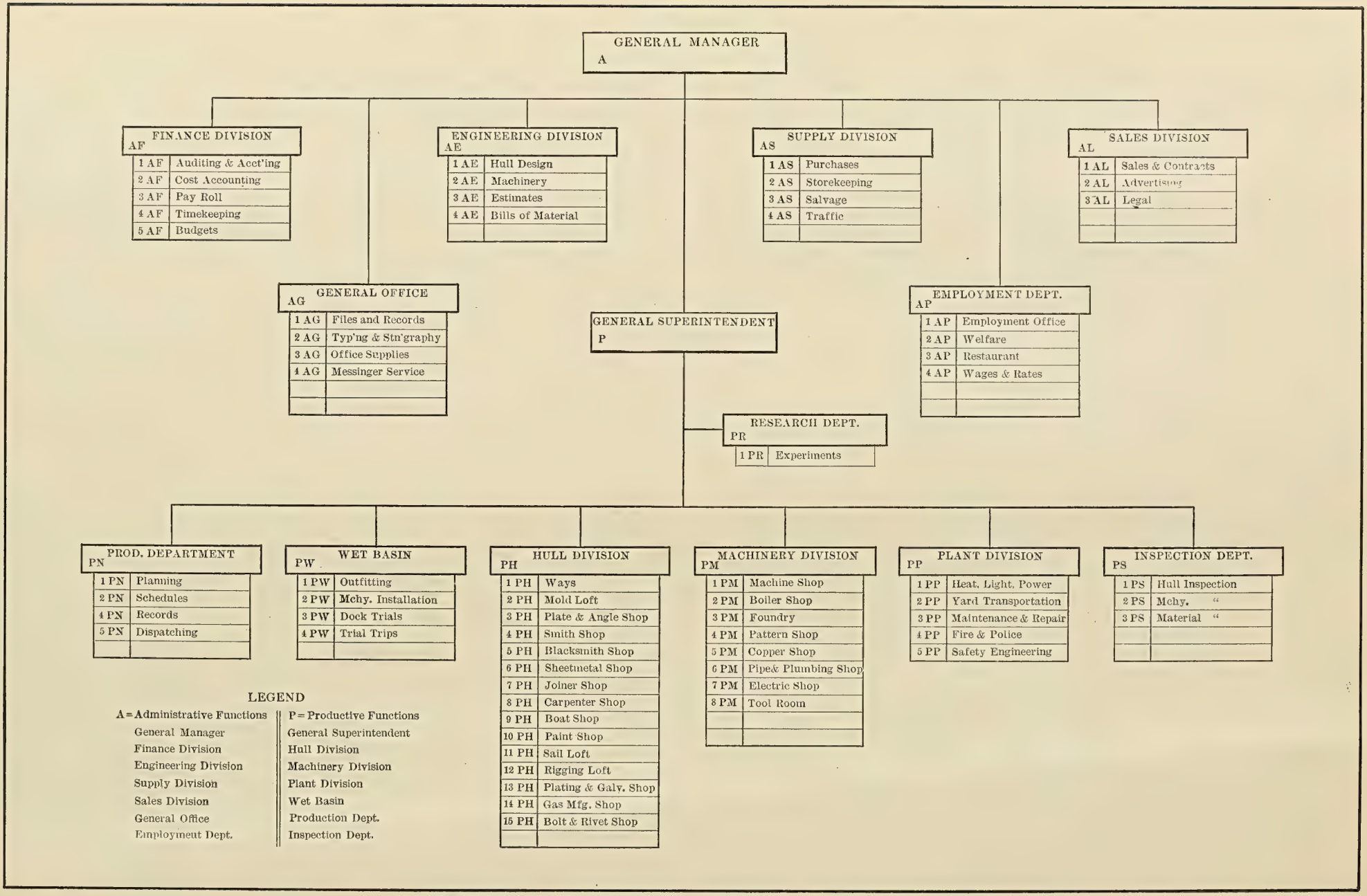


Fig. 1.—Typical Shipyard Organization Developed for Uniform Cost System

A Cost System for Shipyards—II

Development of a Cost System—Method of Organization—Symbols Used in Collecting Cost Data

BY CREIGHTON CHURCHILL*

In addition to the definition of the cost and structural classification, it is necessary for analytical cost purposes to provide some simple means of identifying current activities of production centers with the general scheme so that as little effort as possible will be expended in collecting cost data. This is best done by a system of mnemonic symbols in combination with a scheme of workmen's numbers by which costs are allocated first to the production center or shop and then to the particular craft or trade in that production center.

Organization, Symbols and Employee's Numbers

All industry, of whatever nature, is carried on and directed by some sort of an organization patterned on lines which provide more or less thoroughly for the execution of all the functions involved. In addition, the activities of any manufacturing industry can be separated into two general functions, namely, administrative and productive or operative. Under each of these general functions a further subdivision into other and more detailed functions may be made, depending on the nature of the industry. As these activities are controlled through the proper functioning of certain subdivisions of the organization, it seems logical to take the plan of the organization as a basis for collecting data necessary to the conduct of the business. Working from this point of view, and avoiding the pitfall of collecting data under various methods which have no intimate direct connection with each other, accurate, adequate and timely information is sure to be secured at a minimum cost. It is simply a case of working from a general plan down to the details rather than from the details up to several independent plans and then combining these independent plans to form a general plan. It is obvious that the former method is the more logical way, on the theory of reasoning from cause to effect, to approach a problem.

In order to make the basis for the development of a uniform cost system quite clear and put it before shipyards in such a way that it can be used without the necessity of changes in individual organizations, a typical shipyard organization has been drawn up. Incidentally, this typical organization is a composite result of the organizations existing in over 50 percent of the steel yards of the country.

The key to the method of symbols is based on the assignment of a letter or combination of letters and numbers to each of the various divisions and subdivisions of the organization so that each symbol will be indicative of the part of the organization to which it refers. For example, the letters *A* and *P* are assigned to the general administrative and productive functions respectively, the letters *H* and *M* to the hull and machinery divisions respectively, and so on. A combination of such letters with a number prefixed serves to identify the various subdivisions, as *1PH* for the ways and *3PM* for the foundry. The following tables and the chart, Fig. 1, will make this perfectly clear. In the tables the stores symbols are provided to meet requirements which will be described later.

*Member of firm of Churchill & MacLeod, New York.

A. *Administrative*—Chief executive in direct charge.
- M. Management Division—General officers and general supervision.
- E. Engineering Division—Hull and machinery design and specifications, material lists.
- S. Supply Division—Purchases, salvage, stockkeeping, traffic.
- F. Finance Division—Auditing and accounting, costs and estimates, payroll, timekeeping.
- L. Sales Division—Sales, contracts, advertising, legal.
- P. Employment, welfare, restaurant.
- G. General Office—Files, records, typing, stenography, supplies.

P. *Productive*—Works manager or general superintendent in direct charge.
- H. Hull Division—Ways and shops.
- M. Machinery Division—Shops.
- P. Plant Division—Power house, yard transportation, maintenance, safety.
- N. Production Department—Planning, schedules, dispatching, records.
- S. Inspection department—Hull, machinery, materials.
- W. Wet Basin—Outfitting, machinery installation, trial trips.
- R. Research Department—Experiments, new tools and equipment, tests.

M. *Material*—General storekeeper in direct charge.
- T. Contract Stores—Stores to specified contracts or jobs.
- R. Raw Material Stores—Pig tin, copper, pig iron, sheet metal, etc.
- S. Steel Stores—Plates, shapes.
- L. Lumber Stores—Ways, carpenter, joiner, pattern.
- P. Shop Stores—Shop supplies.
- G. General Stores—Fuel, building materials other than lumber, etc.

A. *Administrative*

AM—Management Division.
- 1AM—General officers.
- 2AM—General supervision.
- 3AM—Miscellaneous expense.
- etc.

AE—Engineering Division.
- 1AE—Hull drafting and estimates.
- 2AE—Machinery drafting and estimates.
- etc.

AS—Supply Division
- 1AS—Purchases.
- 2AS—Storekeeping.
- 3AS—Salvage.
- 4AS—Traffic.
- etc.

AG—General Office.
- 1AG—Files and records.
- 2AG—Typing and stenography.
- 3AG—Office supplies.
- etc.

AF—Finance Division.
- 1AF—Auditing and accounting.
- 2AF—Cost accounting.
- etc.

AL—Sales Division.
- 1AL—Sales and contracts.
- 2AL—Advertising.
- 3AL—Legal.
- etc.

AP—Employment Department.
- 1AP—Employment office.
- 2AP—Welfare.
- 3AP—Restaurant.
- etc.

P. *Productive*

PH—Hull Division.
1PH—Ways.
2PH—Mold loft.
3PH—Plate and angle shop.
4PH—Smith shop.
5PH—Blacksmith shop.
6PH—Sheet metal shop.
7PH—Joiner shop.
8PH—Carpenter shop.
9PH—Boat shop.
10PH—Paint shop.
11PH—Sail loft.
12PH—Rigging loft.
13PH—Plating and galvanizing shop.
14PH—Gas manufacturing shop.
15PH—Bolt and rivet shop.
etc.

PM—Machinery Division.
1PM—Machine shop.
2PM—Boiler shop.
3PM—Foundry.
4PM—Pattern shop.
5PM—Copper shop.
6PM—Pipe and plumbing shop.
7PM—Electric shop.
8PM—Tool room.
etc.

PW—Wet Basin.
1PW—Outfitting.
2PW—Machinery installation.
3PW—Dock trials and trial trips.
etc.

PP—Plant Division.
1PP—Heat, light and power.
2PP—Yard transportation.
3PP—Maintenance and repair.
etc.

PN—Production Department.
1PN—Planning.
2PN—Schedules.
3PN—Dispatching.
4PN—Records.
etc.

PR—Research Department.
1PR—Experiments.
etc.

PS—Inspection Department.
1PS—Hull inspection.
2PS—Machinery inspection.
3PS—Material inspection.
etc.

M. *Materials.*

MT—Contract stores.
MR—Raw materials.
MS—Steel stores.
ML—Lumber stores.
MP—Shop stores.
MG—General stores.
etc.

The numbering system for employees is arranged so that the numbers are tied in with the symbols in such a way as to indicate the unit of the organization to which an employee belongs. Obviously this simplifies the preparation of payrolls by units which is necessary for comprehensive cost analyses and is of material assistance in compiling costs by trades or crafts where desirable. This is further simplified by the use of tabulating machines, as will be seen later.

Administrative

All numbers assigned to consist of three digits and run from 100 to 299, with division letters prefixed.

Examples:
1AE 001 1AE 299—Hull drafting and estimates.
2AS 001 2AS 299—Storekeeping.
3AS 001 3AP 299—Restaurant.
etc.

Productive

Direct Labor.—All numbers assigned to consist of four digits from 1000 to 9999 with shop or department symbol prefixed, with certain series assigned to certain trades or occupations, as may be desirable. Gang foremen, quartermen and leading men go with their respective trades.

Examples:
Ways—
1PH 1000 to 1PH 1999—Riveting gangs.
1PH 2000 to 1PH 2999—Chippers and calkers.
1PH 3000 to 1PH 3999—Drillers and reamers.
etc.

Mold Loft—
2PH 1000 to 2PH 1999—Mold loftsmen.
etc.

Plate and Angle Shop—
3PH 1000 to 3PH 1999—Riveting gangs.
3PH 2000 to 3PH 2999—Chippers and calkers.
3PH 3000 to 3PH 3999—Drillers and reamers.
etc.

Machine Shop—
1PM 1000 to 1PM 1999—Machinists and helpers.
1PM 2000 to 1PM 2999—Machine operators.
1PM 3000 to 1PM 3999—Bench hands.
etc.

Boiler Shop—
2PM 1000 to 2PM 1999—Boiler makers and helpers.
etc.

Foundry—
3PM 1000 to 3PM 1999—Molders and helpers.
3PM 2000 to 3PM 2999—Coremakers and helpers.
etc.

and so on for direct labor in each shop or department.

Indirect Labor.—All numbers assigned to consist of three digits from 300 to 999 with the shop or department symbol prefixed, and certain series assigned to certain occupations. Supervisory indirect labor to be designated as above, except that series will run from 001 to 099.

Examples:
1PH 001 to 1PH 099—Ways supervision.
1PM 001 to 1PM 099—Machine shop supervision.
1PH 300 to 1PH 399—Ways office.
1PM 300 to 1PM 399—Machine shop office.
1PH 500 to 1PH 999—Way laborers.
1PM 500 to 1PM 999—Machine shop laborers.
3PP 500 to 3PP 999—Maintenance laborers.
etc.

Indirect labor or clerical help in the production divisional offices will be designated by numbers consisting of three digits running from 300 to 399, with divisional symbol prefixed.

Examples:
P 300 to P 399—General superintendent's office.
PP 300 to PP 399—Plant superintendent's office.
PH 300 to PH 399—Hull division superintendent's office.
PW 300 to PW 399—Wet basin superintendent's office.
etc.

It will be noted that a system of employees' numbers as outlined provides for a maximum of flexibility and for a considerable range in labor turnover without disturbing the general scheme. By readjusting the numerical series it can be made to fit the largest and smallest organization equally well.

The Development

Up to this point the discussion of the subject matter has been, in effect, an orderly arrangement of the contributing factors to a cost system, which is based on the nature of the shipbuilding industry. Should an actual installation of the proposed system be undertaken it is obvious that it would be necessary to go into greater detail, particularly in the arrangement of erection schedules and hull sections, in accordance with the structural classification. In fact, in this particular respect, it might be well worth while to consider a system of marking steel in accordance with the structural classification, so that each piece will carry its own identification from the storage yard to its place in the hull and enable the workman or timekeeper to read as

he runs. This suggestion is made in the hope that it will receive careful consideration, as it is not deemed within the province of a paper of this kind to discuss piecemarks, due to the fact that it is not its purpose to suggest any radical changes in methods. At some future date the writer hopes to publish another paper dealing with this subject alone and pointing out the advantages to be derived from a change in the present methods of marking steel.

The entire purpose of any cost system is to tell a true story and afford the means of analyzing conditions to the end that executives will be in constant touch with things as they are. Consequently any such system should fulfill the following requirements:

1. Provide for all charges for direct labor and direct material.
2. Provide for all charges for indirect labor and indirect material, located at its source as far as possible.
3. Provide for overhead charges other than those in (2).
4. Provide for charges to structural classification.
5. Provide for charges to crafts where necessary or desirable.
6. Provide data for unit cost of all classes of output.
7. Provide data for estimating in accordance with structural classification.
8. Provide data for cost analyses.

It will be assumed that adequate work and material records are being made covering labor and material expended on construction, maintenance and repairs. In other words, that the time cards or work tickets, material orders, maintenance or repair orders, job orders, etc., contain all the information required and are practical as to form and use.

Using the typical organization as a basis for a cost system, it is clear that the division, department and shop symbols provide the means to allocate charges at their source, and, inasmuch as these symbols are all derived from the master symbol identifying the various sources of activity, a system is at hand for designating accounts such that charges automatically go where they belong. By prefixing numbers to the symbols, provision is made for subdividing the various charges under any main division to any extent desired. Reference to the chart will show this without further explanation.

It is a comparatively simple matter from one point of view to fill in the proper contract number, hull number or job order number, but from another point of view, that of the foreman, timekeeper or workman, it is not so simple. A scheme has therefore been evolved to eliminate as much as possible all of this difficulty and at the same time to give all the information possible. It consists of a series of numbers standing for certain classifications covering the activities of a plant to any desired extent. These numbers affixed to a shop symbol give a charge number so that anyone concerned having the key can make the charge to the proper account. In fact, the classification selected forms the basis for a series of standing orders which cover the activities of the entire working force. The classification taken, which is subject to extension, is as follows:

Standing Orders—Output

10.	Main steel structure.....	Labor and Material
11.	Secondary structure.....	" " "
12.	Hull fittings.....	" " "
13.	Carpenter work.....	" " "
14.	Joiner work.....	" " "
15.	Cementing, painting and deck coverings	" " "
16.	Operating equipment.....	" " "
17.	Furniture, furnishings and outfits	Labor and Material " " "
18.	Hull machinery, hull engineering	" " "
19.	Propelling machinery.....	" " "
	Etc.	

Any items in the above classification which are purchased outside are to be charged, upon receipt, to the proper stores account until they are issued, at which time they are charged out to a charge number made up of the hull number, to allocate the charge to the proper hull, and the standing order number to cover the classification. For example, a windlass for Hull No. 17 would be entered on the material order as charged to 17-18 when issued from the stores, the labor for the foundations to 17-1PW-11, material for foundations to 17-11 and the labor for installation to 17-2PW-11. It will be noticed that material charges for direct material contain only a combination of the hull and structural classification numbers, while labor charges are made up of the hull number, shop symbol and the structural classification number. The object to be accomplished by this is to enable labor charges to be automatically separated from material charges for the purposes of cost analyses.

Standing Orders—Maintenance and Repairs

100.	Land and appurtenances...	Labor and Material
101.	Buildings and structures...	" " "
102.	Plant appliances and equipment	" " "
103.	Machinery and machine tools	" " "
104.	Consumable supplies.....	" " "
105.	Losses and spoiled work...	" " "
106.	Salvage	" " "
	Etc.	

This maintenance or operating expense classification follows the same general idea as that for output, except that both labor and material charges are composed of the shop symbol and classification number, the distinguishing feature being that the classification number is always made up of three digits. For example, the labor for repairs to a locomotive crane would be charged to 2PP-102, as would also any material drawn from stores for such repairs. There would be no conflict with this charge, as the workman's time card or work ticket would indicate the labor costs and the material order would show the material. Again, labor and material for repairs to the roof of the foundry would both be charged to 3PM-101.

In all cases of maintenance charges the description of the work in the body of the repair order, work ticket or material order will enable the charge to be made to the individual machine, appliance or structure, as the case may be. The main object, however, is to classify all maintenance charges to shops in order to allocate operating charges at their source so that a check may be kept on fluctuations. For example, an analysis of a marked increase in the maintenance charged under classification 102 might develop that a certain locomotive crane was costing so much for repairs that it would be good business to scrap it and replace it with a new one.

Standing Orders—General Expense

1000. Executive and department head salaries.
1001. Clerical and drafting room salaries, except where latter can be charged direct to job.
1002. Indirect labor and material.
1003. Plant, builders' risk and liability insurance premiums.
1004. Taxes, ex-corporation and federal.

1005. Depreciation.
1006. Rent of equipment, including power, light and heat.
1007. Registration, inspection fees, etc.
1008. Costs of molds, templates and designs when not chargeable direct to job.
1009. Reasonable allowance for spoiled work.
1010. Office expense, including supplies, telegraph and telephone service.
1011. Transportation for employees.
1012. Welfare work, including reasonable restaurant losses, if any.
1013. Necessary travel expense.
Etc.

It will be noticed that indirect labor and material are also covered under "standing orders—maintenance." This is intentional, as "standing orders—general expense" are for the general accounting and not for cost accounting. The cost accounting department reports all indirect labor and material charges within its jurisdiction as a lump sum to general accounting, and it, in turn, reports all other overhead within its jurisdiction to cost accounting for cost purposes. In connection with "standing orders—general expense," special attention is called to the charges excluded from overhead in the "definition of costs."

In some respects "standing orders—general expense" are foreign to cost accounting as far as the actual detail is concerned. They are mentioned here to provide a point of contact to merge cost accounting with the general accounts or vice versa. For the purpose of allocating at its source all the overhead possible, cost accounting is directly concerned with indirect labor and material. All other overhead is reported in a lump sum by general accounting and for cost purposes is distributed by cost accounting to the different sources of operating in the proper proportion. It has been suggested that this distribution be made either on a basis of direct labor or plant value at the sources of activity, whichever may seem the most equitable. The former will place it in proportion to actual work being performed at the different sources, which may vary for different periods, while the latter will be purely on a basis of value of structure and equipment. With capacity business on the books either way would seem fair. On the contrary, without capacity business either way would absorb all overhead, which is not good practice. This question of the distribution of overhead always appears in the consideration of costs, and in some industries has been satisfactorily disposed of through the method of machine hour rates. This latter method, however, does not appeal to the writer as suitable to the shipbuilding industry for several reasons, hence the following is offered as a suggestion:

When a plant is working to normal capacity direct labor is a good measure to represent the activities under such conditions. Under less favorable conditions direct labor will decrease to a point necesary to maintain the required output and again will be a measure for current activities. If, therefore, it is not considered good practice to charge idle equipment to overhead, it is equally unfair to charge other closely related items of overhead to current business. For example, it would be very ill-advised to jeopardize the organization by combining two department under one head due to poor business, yet, at the same time, it is well known that the business cannot stand the burden of the two heads unless conditions improve. On the other hand, if current conditions are used as a basis for going after more business, the overhead charges will be excessive and new business will not be attracted. Following out of this line of argument will lead to the only logical solution of this question, which is to standardize overhead, as well as other items of cost, on a basis of normal conditions, having due regard, of course, to changes beyond control. Having done so and accepting direct labor as a measure of current activities, the standardized overhead should be distributed in proportion to direct labor. For example, if the normal overhead of the fabricating shops distributed as heretofore outlined was a certain sum and current business on a direct labor basis showed but 60 percent of normal, then but 60 percent of this certain sum would be the current overhead charge against these shops. Bids for new business on such a basis should be much more successful than those based on absorbing all of the overhead irrespective of actual conditions. The absorption of undistributed overhead into profit and loss is a risk of the business, and the best way to reduce this risk to nothing is to make prices truly representative of actual costs. As a matter of fact, in the example cited, the profit and loss account would not have to absorb 40 percent of the standard overhead because the total overhead would naturally be somewhat reduced if a plant were operating at 60 percent of normal capacity.

Before leaving this matter it might be well to call attention to one item of expense that should not be charged to overhead, and that is selling and advertising expense. Applying the same line of reasoning, it will be seen that the expense of aquiring new business should not be charged to overhead until the business is secured, and certainly it should not be charged to business already on the books. While such expense will be charged eventually into final costs, it should be absorbed in the profit and loss account as a matter of good practice. This is based on the principle that market prices will stand a certain amount of this expense provided the business is secured.

(To be concluded.)

Port Facilities at St. Nazaire and Nantes

The development of the trade and industries of the lower Loire region depends entirely upon the improvements of the harbor facilities at St. Nazaire and Nantes, says Consul General G. Bie Ravndal in a recent issue of *Commerce Reports.*

St. Nazaire-Nantes is capable not only of becoming the chief port on the Atlantic coast of France, but also of competing with Belgian, Dutch and German ports for the commerce of central Europe.

Even now St. Nazaire receives ships of 15,000 tons, while Nantes accommodates vessels of 7,500 tons. There are docking, discharge, warehouse and railroad facilities to meet the needs of some 50 vessels of various dimensions at each place simultaneously. It should be noted that the building of docks, the deepening of the river, the installation of cranes and similar port works are constantly being pursued in accordance with the official programme as established by the law of July 7, 1913.

The chief drawback is the difficulty of obtaining return cargo, and, therefore, the growth of the port is dependent not only upon increased dredging operations, but also upon closer connections with inland sources of freight supply, including those of Alsace-Lorraine, as it is a question whether the iron ore, marble and other raw materials and manufactures available in the Loire Valley will even approximately solve the problem.

It is likely, however, that the momentum afforded by the war will continue to affect the fortunes of the St. Nazaire-Nantes port so that, after the departure of American transpors, it will still show an increase of business over pre-war conditions and a marked tendency toward accelerated expansion.

Diesel Engines and the Merchant Marine

What Motorships Have Accomplished on the Pacific Coast—Attitude of Shipowners Towards the Diesel Engine—Performance of the Libby Maine

IN an endeavor to answer the question: Why is the internal combustion engine not used more extensively for marine propulsion? the San Francisco Section of the American Society of Mechanical Engineers devoted its meeting of December 19, 1918, to a discussion of the Diesel engine as applied to the merchant marine, and the following report was published in *Mechanical Engineering*, the official organ of the society. The papers presented were chiefly a record of past performances of motorships on the Pacific Coast, but it was also pointed out that the internal combustion engines are rapidly assuming greater importance, and may ultimately replace the steam engine.

Bruce Lloyd, marine engineer for the Concrete Ship Section of the Emergency Fleet Corporation, discussed the attitude of the ship owner and gave valuable data of performances. George A. Dow, president of the Dow Pump & Diesel Engine Company, presented a paper on the Diesel oil engines of the motorship *Libby Maine*. Both of these papers are abstracted below.

J. H. Hanson, president of the Skandia Pacific Oil Engine Company, also read a short paper illustrated by about forty slides, covering the history and development of Diesel engines and showing some of the more recent installations on ocean-going vessels.

Perhaps the most interesting fact brought out by Mr. Hanson's remarks was the statement that there are nearly 800 motorships varying from 1,000 to 12,000 tons capacity now in operation. Some of these ships are making from 40- to 50-day continuous runs covering more than 10,000 miles and carrying cargo of 11,000 tons. These ships consume during such voyages 400 tons of fuel oil instead of the usual 1,500 tons of coal of the ordinary steamer, with a resulting saving of approximately 1,000 tons in fuel, and in addition making another thousand tons of cargo space.

Diesel Engines on the Pacific Coast

BY BRUCE LLOYD

The development of the steam engine, extending over a period of about one hundred years, has now reached such a stage that it is probably one of the most perfect machines that has ever been produced. The steam engine is wonderfully smooth-running and possesses great flexibility of power. And yet the ship owner is constantly being urged to discard his steam engine and install internal combustion engines, and for the simple reason that the steam engine is not complete in itself. Its future is doomed by its necessary adjunct, the steam generator, which has never been improved so as to remove its attendant danger and other well-known disadvantages.

The space occupied by the boiler in a steamship, together with the large amount of room necessary for fuel, is the most perplexing problem that presents itself in the construction of a serviceable and economical cargo carrier. Attempts have been made to overcome this objectionable feature by placing the boilers on the upper deck of the ship, which is not so valuable for cargo space; but the fact remains that the boilers are still on board, adding at least their weight and detracting just so much from the general efficiency of the vessel.

In spite of the fact that the internal combustion engine overcomes this difficulty and gives a tremendous advantage in cargo-carrying capacity, steam-driven vessels have been clung to with a tenacity equaled only by our forefathers in their unwillingness to discard the sailing ship and adopt the steamer. So strong was their distrust of the steam engine that it is only within the last fifteen years that owners of steamships were able to overcome their fears that the steam engine might break down and dependence have to be placed on sails, as all ships up to that time were provided with considerable sail area.

There are, however, other and perhaps more weighty reasons which prevent the ship owner from adopting the internal combustion engine. Almost every port is provided with facilities for repairing the boilers and engines of the ordinary steamship; and engineers skilled in the operation of a steam engine are always available. On the other hand, facilities for ships whose motive power is the fuel-oil engine are not even now available.

Despite these disadvantages, however, the internal combustion engine is rapidly being adopted by ship owners, and any reliable record of performance is at once a source of interest.

During the past two and one-half years 16 vessels on the Pacific Coast have been equipped with the Bolinder crude-oil engine, manufactured by J. C. Bolinder, of Sweden. Ten of these are so-called auxiliary ships in which the sail power predominates. All of them are engaged in overseas trade, visiting ports where fuel is either not available or only at prohibitive prices. Fuel tankage had therefore to be provided, of sufficient capacity to supply the engine, when running at full speed, for a voyage outward and homeward of nearly 17,000 miles.

These ships vary in size from 1,500 to 3,500 deadweight tons, and the size of the engines with which they are equipped ranges from 320 to 600 horsepower. These engines are of the direct-reversible type. They have no camshafts or intricate gearing; a small compressor driven off the forward end of the crankshaft supplies air for vaporizing the fuel on entering the cylinder, and the reversal of the engine is affected by preignition.

The first large auxiliary ship equipped was the *City of Portland*, one of the three sister ships built and owned by the McCormick Steamship Company, of San Francisco. These vessels are approximately of 3,500 deadweight tonnage and are equipped with twin engines of 320 brake horsepower each. The engines have often run continuously for 45 days. The average speed maintained was 6.8 knots, but when the engines were allowed to develop their full power the speed averaged 7.5 knots. The sails were of practically no use on any of these voyages, and these vessels would more properly be designated as low-powered motorships.

The daily fuel consumption averaged 23 barrels of oil of 24 degrees Beaume gravity, and for a voyage covering 17,000 miles, 1,997 barrels of fuel oil were used.

The motorships that have attracted the greatest attention, however, are the full-powered vessels, as these afford the best opportunity of comparison with steamships. Four such motorships (twin-screw) have lately been added to the fleet of W. R. Grace & Company. They are excellent examples of the possibilities of moderate-sized ships equipped with fuel-oil engines. These ships, all of the same design, are the *Santa Elena, Santa Isabel, Santa*

Cristina and *Santa Flavia,* and their dimensions are as follows: Length, 235 feet; breadth, 42 feet; depth, 29 feet; cargo capacity, about 2,000 tons on 18-foot 6-inch draft. The propelling machinery of each ship consists of two 320-brake-horsepower Bolinder engines. The main fuel supply is carried in steel tanks having a total capacity of 1,770 barrels, sufficient for nearly 75-days' running, and the extensive radius over which these vessels are able to travel without refueling gives them an immense advantage over the ordinary steamer. The auxiliary machinery consists of one 15-brake-horsepower Bolinder engine direct-connected to a 10-kilowatt generator and one rotary pump of 2,500 gallons capacity; also one 8-brake-horsepower Bolinder engine connected to a 5-kilowatt generator and rotary compressor. These ships carry a refrigerating plant consisting of a 1-ton Brunswick motor-driven ice machine, and each has about 600 cubic feet of refrigerating space. All of these vessels have completed voyages to New York, via Valparaiso, calling at other South American ports and the Panama Canal—a distance of over 14,000 miles, at an average speed of 180 nautical miles per day.

The engine troubles that developed have been chiefly cracked cylinder heads and broken compressor shafts. It was noted that the fracturing of the cylinder heads always occurred while maneuvering the engine in entering or leaving port, and never at sea. This, it was found, was caused by the overheating of the head when the engine stopped, as the circulating pump of the water-cooling system was driven from the main crankshaft. The sudden cooling and contraction which thus took place when the engine was started again has been entirely eliminated by devising means to keep a constant circulation of water through the cylinder heads even while the engine is at rest.

The breaking of the compressor shaft which occurred in the first three installations was due to a mistake in design which was quickly and easily rectified, and there has never been a recurrence of this trouble.

A steel motorship of 3,500 tons carries on a direct voyage of 8,000 to 10,000 miles nearly as much revenue-producing cargo as a steel steamer of 5,000 tons of the same speed, as the following table clearly shows:

	Motorship	Steamer
Deadweight tonnage	3,500	5,000
Fuel oil for 45 days at 5 tons per day, tons	225	....
Coal for 45 days at 25 tons per day, tons	....	1,125
Water for boiler, tons	....	100
Net paying cargo, tons (deadweight tonnage minus fuel and water)	3,275	3,875

It is not intended, however, to advocate the internal combustion engine for passenger ships, or for vessels carrying cargoes which must be transported within the shortest possible time, since in these cases the necessity for speed relegates the question of economy to a place of secondary importance.

Merchant ships and steamers, on the other hand, are operated solely for profit, and the hull that can carry the most cargo at the lowest cost is obviously the best.

In 1911 a ship propelled by a new type of engine entered our port after making a most successful voyage from Copenhagen, Denmark. This vessel, the motorship *Siam,* was owned by the East Asiatic Company and equipped with a type of engine known in Europe as the Diesel engine. Vessels propelled by this new type of engine repeatedly visited our coast and soon were making the trip to the Pacific Coast and thence to the Orient and back in a perfectly satisfactory and efficient manner.

In 1916, when ships were greatly needed to carry our products to Europe and were being built as rapidly as possible, the great problem of obtaining machinery presented itself. Engine manufacturers were building steam engines and boilers for large steel ships and could give no time to the building of engines for smaller craft. The average ship owner was therefore glad to get whatever he could.

When the wooden sailing vessel was decided upon to meet the great emergency, the so-called semi-Diesel type of engine was adopted as an auxiliary. Subsequently, however, it was used as a full-powered propelling unit, and thus a practice new to the shipping men of the Pacific Coast and untried by the manufacturers came into vogue. Since this proposition at once had associated with it the successful practice of the Europeans, the semi-Diesel gained great popularity.

A good many types of American-built Diesel engines have been installed and tried out. Marine engineers have had their opportunities to prove their skill in operating them, and the time is rapidly approaching when the ship owner will see that the American-built internal combustion engine occupies a front-rank position as a prime mover in ship propulsion.

Performance of the Libby Maine

BY GEORGE A. DOW

A Diesel engine installation watched with unusual interest on the Pacific Coast is that on the *Libby Maine.* This vessel is a 2,000-ton wooden ship of very rugged construction, and built especially for severe arctic service. She is 240 feet long, 43 feet beam, 24 feet molded depth, has a mean draft of 22 feet 8 inches, and is equipped with two 424-indicated-horsepower Dow full-Diesel-type oil engines. These are direct reversible and are connected through Falk reduction gears and Nutall flexible couplings. Each unit is tied to an engine bedding designed to give the maximum stiffness and greatest security against deflection. Heavy timbering securely bolted to the ship's frames runs in single lengths the entire length of the engine unit. The Nutall flexible coupling is placed between the main engine and reduction gear to relieve any possible strains between these units, as well as to act as a float. The reduction gear and thrust block are bolted to a single heavy cast iron sub-base. By the use of the reduction gear the most efficient engine speed of 250 revolutions per minute and the most efficient propeller speed for this size of ship, 100 revolutions per minute, are obtained.

The engines installed in the *Libby Maine* are of the six-cylinder open A-frame type of construction. Six cylinders were used in order to give maximum flexibility and positive starting positions, and the A-frame design was adhered to because it afforded the greatest accessibility to the bearings and pins. Marine engineers are anxious to know where their pins and bearings stand and feel more secure when they are able to "feel" parts subject to heating.

The cylinders are separate castings; cylinder heads are of standard box construction, and pistons are of the long trunk type. The crankshaft is in two sections, the forward and after section being interchangeable. The lubricating system is controlled by drip oilers, the oil being measured into individual positively timed oil pumps attached to each A-frame. One plunger of this pump supplies the piston lubrication and the other the piston pin. The main bearings are lubricated by ring oilers and the crankpin by centrifugal oil rings.

The operation of the entire engine is controlled by three levers centralized at one station. A noved feature of this installation is that one man is able to control both engines from one platform. Even in the treacherous waters of the Bering Sea this control was absolutely responsive to the captain's wish.

Two levers are used to govern the action of the engine, while the reversing mechanism is manipulated by the third lever. Reversing is accomplished by the single movement of a vertical sliding cam, actuated by an oil-compensated air piston, which automatically lifts the cam rollers clear of all the cams, then slides the camshaft to the desired position and finally returns the cam rollers to the cams, thereby giving the proper timing of the valves for the new direction of rotation.

Air pressure is then applied to the pistons of the engine through the air-starting valves by a single movement of the control lever until momentum is acquired, when another single movement of the same control lever automatically cuts off the air pressure and admits the fuel oil to the cylinders. The entire mechanism is thoroughly interlocked to guard against any false move on the part of the operator. Automatic locking devices block the execution of any movement not made in the proper sequence. The speed of reversal is controlled by the pressure of the air applied to the air piston of the reversing cylinder and the regulation of the velocity of oil displacement from one side of the piston to the other.

In order to obtain flexibility of operation, economic use of starting air, and added security against a shutdown of the entire unit, two control levers are provided, one lever for each set of three cylinders.

The general characteristics of the engine are: Indicated horsepower, 425; bore, 12 inches; stroke, 18 inches; crankshaft diameter, 7½ inches; speed, 250 revolutions per minute; floor space, 20 feet by 5 feet 1 inch; height above center of crankshaft, 8 feet 10 inches; approximate net weight, 125,000 pounds.

An ideal trip from Seattle to Honolulu and return to San Francisco was experienced and a record in fuel economy made. Extracts from the official log indicate the following:

Fuel-oil consumption, barrels	259.5
Total distance, miles	2,440
Time of voyage	14 days, 18 hours, 15 minutes
Average economy, gallons per nautical mile	4.46
Average speed, knots	7

From San Francisco to Seattle very heavy weather was encountered. The chief engineer reported that the screw was out of the water half of the time, but no racing occurred at any time, due to the perfect action of the governors.

The engines of the *Libby Maine* are an example of approved European practice adapted to the needs of the Pacific Coast and stand as a milestone of progress in the use of the internal combustion engine as applied to marine propulsion.

Tests of Merchant-Ship-Type Diesel Engines

THE official trials of two 1,200-indicated-horsepower (750 brake horsepower) Diesel engines built by J. Samuel White & Company for the British Admiralty, were recently carried out in accordance with the special requirements of the British naval authorities and in the presence of their representatives. The engines are direct-reversible, two-cycle, single-acting, stepped-piston type, six-cylinder, 14½-inch bore by 24-inch stroke, and have a weight complete of 70¼ long tons.

The trials of the first engine consisted of 96 hours of uninterrupted running at the full load of 750 brake horsepower at a speed of about 200 revolutions per minute. During the whole trial the engine ran satisfactorily without any stoppage and without any sign of overheating either in the cooling system or working parts. The exhaust was quite invisible and very little soot was observed after the completion of the trial. The temperatures at the end of the trial were practically the same as those attained at the end of the first hour. The circulating water was passed through the engine by steam pumps, the quantity per brake horsepower being approximately 11.2 gallons. Additional maneuvering trials were carried out with the port engine consisting of astern running, time taken to pump up the starting reservoirs, slow-speed running and the drop in pressure of the starting air after each start.

Table 1 is representative of the results obtained in the 96-hour trial of the starboard engine, while Table 2 gives data on lubrication and also the heat balance of the engine.

TABLE 1.—DATA ON 96-HOUR TRIAL OF STARBOARD ENGINE

Mean brake horsepower	751.8
Mean revolutions per minute	190.5
Mean indicated horsepower	1,215.6
Mechanical efficiency, percent	61.84
Total revolutions for 96 hours	1,097,307
Total pounds of fuel oil used during 96 hours	35,205
Fuel per brake horsepower per hour, pound	0.487
Total lubricating and cooling oil used for 96 hours, pounds	887.7
Mean lubricating and cooling oil per brake horsepower per hour, pound	0.0123
Mean temperature of cooling water, inlet, degrees F.	61.5
Mean temperature of cooling water, outlet, degrees F.	99.5
Mean temperature of piston oil cooling, inlet, degrees F.	90
Mean temperature of piston oil cooling, outlet, degrees F.	125
Atmospheric temperature of test shop, degrees F.	61.5
Injection air pressure (mean), pounds per square inch	1,000
Scavenge air pressure (mean), pounds per square inch	7
Air Compressors:	
I.P. air cooler pressure (mean), pounds per square inch	127
L.P. air cooler pressure (mean), pounds per square inch	27
Circulating cooling water pressure (mean), pounds per square inch	5
Piston cooling and lubricating oil pressure (mean), pounds per square inch	61.56
Compressor suction open, percent of total	5.35
Mean indicated pressure of No. 1 cylinder, pounds per square inch	110
Mean indicated pressure of No. 2 cylinder, pounds per square inch	106.7
Mean indicated pressure of No. 3 cylinder, pounds per square inch	108.4
Mean indicated pressure of No. 4 cylinder, pounds per square inch	103.4
Mean indicated pressure of No. 5 cylinder, pounds per square inch	117.0
Mean indicated pressure of No. 6 cylinder, pounds per square inch	102.5

Blast air used per brake horsepower = 0.22 cubic foot.

TABLE 2.—DATA ON LUBRICATION—HEAT BALANCE OF ENGINE

	Pounds	Ounce
Oil for power and scavenge pistons and L. P. compressor pistons	80	0
Oil for crankshaft and valve gearing	112	0
Oil for piston cooling and bearing lubrication	693	0
Total	885	0

(i. e., 0.22 pound per hour or 0.0123 pound per brake horsepower per hour.

HEAT BALANCE

Calorific value of fuel, British thermal units per pound	19,510
Consumption per brake horsepowwer per hour, pound	0.487
Consumption per indicated horsepower per hour, pound	0.303
Brake horsepower = 751.8 / Indicated horsepower = 1,215.6 — Mechanical efficiency, percent	61.84

$$1 \text{ brake horsepower-hour} = \frac{33{,}000 \times 60}{778} = 2{,}550 \text{ British thermal units.}$$

1 brake horsepower requires 1.62 i.hp., therefore frictional

$$\text{Heat per brake horsepower} = \frac{0.627 \times 33{,}000}{778} \times 60 = 1{,}578 \text{ B.t.u.}$$

Heat taken in per brake horsepower per hour = 19,510 × 0.487 = 9,500 British thermal units.

$$\text{I.hp. heat units per b.hp.} = \frac{1.62 \times 33{,}000}{778} \times 60 = 4{,}120 \text{ B.t.u.}$$

	B.t.u.	Percent	
Heat converted into work on brake	2,550	26.9	43.5 percent
Heat lost in engine friction	1,578	16.6	
Heat converted into indicated work	4,120	43.5	
Heat lost in cooling water	2,480	26.1	100 percent
Heat lost in exhaust gases	2,900	30.4	
Heat taken in per b.hp. per hour	9,500	100.0	

Thermal efficiency of engine = 26.0 percent.

GERMANY'S MERCHANT FLEET.—According to information recently published, Germany now has about 2,000,000 metric tons of merchant shipping. Before the war her mercantile fleet amounted to 5,134,720 tons. Part of this was destroyed and the Allies confiscated 2,500,000 tons. The annual output of German shipyards before the war was about 300,000 metric tons.

Sediment in Marine Boilers

Dangers Arising from This Source—Three Instances Where Sediment May Cause Trouble

BY W. R. AUSTIN

ENGINEERS in charge of multitubular boilers will agree that sediment in such boilers is most objectionable, and anyone called to survey them looks with suspicion when he sees it present in abnormal quantity on its removal from the boilers. It not infrequently happens that furnaces become distorted without the cause or the occasion being known, and observations lead to the belief that not a few accidents of this kind are attributable to the presence of sediment. As inquiries have revealed the fact that many watch-keeping engineers are but imperfectly aware of the dangers arising from its presence in the boilers, these lines are written to point out where the risk of accident generally arises.

If a vessel's boilers were always filled by hose from the shore the quantity of sediment found at the time of cleaning would be very much less. It is, however, not always possible to obtain such water, owing to the absence of facilities, while occasionally one hears of an objection on account of the expense. "Needs must when th de'il drives." The ship must sail, so the engineer is obliged to fill his boilers from the dock or river in which his ship is then lying.

Danger of Using River Water in Boilers

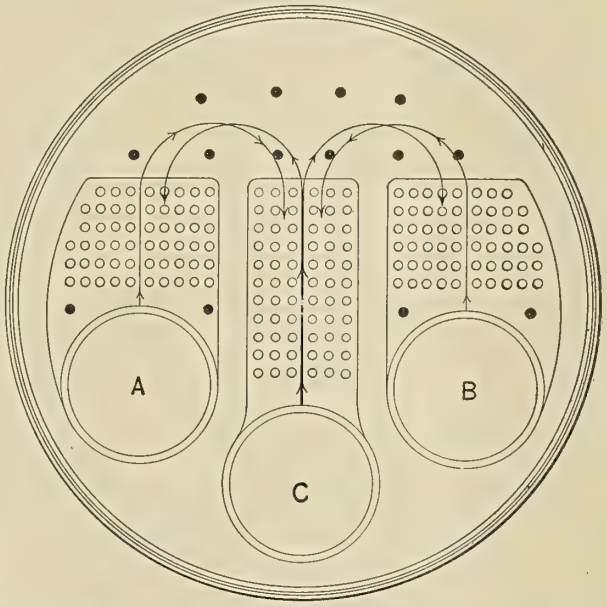
At such a time the water may appear quite clear as viewed from the deck, but appearances are deceptive. As an example, some double-bottom tanks were filled with water from the St. Lawrence River as the ship was proceeding to sea. The water appeared to be clear, yet when the tanks were opened on this side several inches of silt were found on the tank bottoms. It must have come from the river, as when previously filled the tanks had contained sea water.

Blow-off cocks are placed so low down on the ship's bilge that in many docks they are in the immediate vicinity of the mud of the dock bottom, and boilers filled in this way always get with the water a certain amount of sediment. The engineer may have used every means in cleaning the boilers to insure safety in working, but by filling them as indicated he nullifies to a great extent all his care, and admits a most insidious enemy. Once in the boilers sediment becomes a source of danger while they remain under steam. It settles down over the surface of the boiler bottom and its removal by blowing off from the bottom is not very effective, only that portion being ejected which lies within the stream lines of the flowing water close to the mouth of the blow-off pipe.

Precautions in Raising Steam

The first occasion I would mention where risk arises from the presence of sediment is in the act of raising steam. In this operation time is essential. The danger from racking strains caused by unequal expansion is so generally recognized that very few new boilers are now intsalled which have not the means of circulating the water within when raising steam. The danger to the shell is one which looms largely in the eye of the engineer, and ofttimes, it is feared, to the exclusion of another which he has overlooked. He circulates to save the boiler shell from undue strain, but in doing so brings into existence conditions which are detrimental to the furnaces. The movements due to the circulation of the water within the boiler disturb the sediment. It is thrown into circulation and flows with the water currents, whose course is liable to change with any local change of temperature. It thus becomes a menace owing to the variable temperature of the furnaces at such a time.

A specific instance of this is shown by the practice of many engineers who, when raising steam, light up the lower furnaces of a set of boilers before the wing furnaces, by this course avoiding as far as it is possible any inequality of temperature in the structure of the boiler



Sketch Showing the Flow of the Water Currents in Three-Furnace Boiler

shell. If the center furnace only is lighted when the circulation of the water begins, the water rises by convection from the furnace *C*, as shown by the full lines on the sketch, and returns to the lower parts of the boiler via the wing furnaces. The comparatively cool surfaces of the nests of tubes in each of these furnaces assist in smoothing the path of least resistance for the falling currents of water. The sediment is carried by the water, and a part of it falling between the tubes is deposited on the wing furnace crowns *A* and *B*. It lies there, and when these furnaces are lighted up and generate heat, all the elements necessary to produce collapse of the crown plates are present.

Collapse of Furnaces

In some cases a furnace so injured may remain unnoticed until it is subsequently examined. Then, on a search being made no trace of the cause of collapse can be found, as the sediment was thrown off when the plate became distorted. To prevent injury in these circumstances, uniformity of temperature in each furnace is required, and it is suggested that the circulation of the

* Paper read before the Institute of Marine Engineers, London.

naces are lighted and uniformly burning, as thereby the risk of sediment settling on the furnace crown plates would be minimized.

The next occasion on which sediment becomes a menace arises after the ship has put to sea. If rough weather be then experienced, those who at such a time have blown through a gage glass must have noticed that the water after blowing through is much discolored. It resembles in many instances coffee "grounds." This is an indication of the state of the water in the boiler. The rolling of the ship has put the sediment from the bottom of the boiler into circulation, and its presence should be a warning to those in charge. Danger is not likely to arise while all the furnaces are uniformly generating steam, but when the time of cleaning fires comes round then care should be exercised.

Cleaning the Fires

Suppose that a center fire is to be cleaned. The operation is a warm one and firemen delight in having the fire burned well down to the bars. If such a one has his way when the gage glass indicates the presence of sediment, then the furnace crown, always at such a time comparatively cool, becomes a dangerous cooling surface. Hitherto the water and steam had been rising from the crown plate *C*, now its course is reversed, as shown by the dotted lines on the sketch. The wing furnaces *A* and *B* are generating steam rapidly, and the water currents rise from them and then fall with corresponding speed on the furnace crown plate *C*, bringing with them in their descent the sediment in circulation.

The water currents with their burden of sediment always come down heavily over a furnace being cleaned if it has ceased to generate steam, and if the time taken in cleaning a fire is unduly prolonged the accumulation of sediment which settles on the crown plate may easily be such that on the fire becoming thoroughly alight overheating of the plate will take place.

When viewed from this standpoint the operation of cleaning a fire at sea is a most important one and should have close attention from those in charge. It should at the moment of cleaning be kept so bright and alive that it will generate steam, otherwise a critical situation is produced.

It will be evident that these remarks apply to all boilers of the multitubular type no matter what kind of fuel is used to generate steam; the course of the water currents within the boiler being determined by the temperature at which any one or any combination of the furnaces is worked.

In the case of boilers using oil fuel, the oil is injected to the furnace through a burner or burners fitted to the furnace door. Where a single burner is used and this becomes choked or requires renewal the generation of steam in that particular furnace is temporarily stopped. The conditions then produced are in every way similar to those which obtain when cleaning a coal fire which has been burned down too low. The active heating surfaces become cooling surfaces, producing within the boiler an alteration in the direction of the water currents; sediment when showing will fall on the crown plate while the burner is being overhauled with every prospect of damage to the crown plate when it is again lighted and commences to generate heat.

The engineer in the stokehold to save time and suit the steam production to the requirements of the engines frequently shuts off one or more burners to prevent the steam from blowing off. This method of regulating the steam supply, in view of what has been said, is a most reprehensible one and should be strictly prohibited. A uniform heat should be maintained in each furnace by regulating the supply of oil fuel from each burner as may be required for the lessened need of the engines. This course is absolutely essential where single burners are fitted. In cases where twin burners are fitted to each furnace then one of these may be shut off on all furnaces in a case of urgency; but the better course is to regulate the valves which control the fuel supply to the burners. By doing so uniformity of steam production in each furnace is maintained. Evaporation will be reduced, and the risk avoided which is always attendant on shutting off the entire oil fuel supply from any individual furnace.

Sediment Causes Trouble When Fires Are Banked

A third instance where sediment may give trouble occurs when a vessel after rough weather arrives at an anchorage and the boiler fires are banked. The rolling of the ship has ceased, but the sediment is still in suspension in the water. If all the stop valves are then closed the tendency is to stop the circulation and check the rise of steam from the heating surfaces. With banked fires the furnace temperature has fallen considerably, the upward movements of the steam grow more sluggish, and one can conceive a point being reached when steam may be generated on a furnace crown plate and remain there because of the insufficiency of heat necessary to throw it off, backed by the lack of movement in the water. In such circumstances the sediment in suspension falls on the crown plate and becomes a menace. Instances have occurred where loud reports were heard in boilers lying under banked fires, and after the report there was heard gurgling up to the steam space a considerable volume of steam.

As a means of avoiding the risk of accident while lying under banked fires, steam should be used for a considerable time after banking has taken place. By so doing steam generated is drawn to the steam space and the water is kept in circulation until such time as the sediment has settled on the boiler bottom. Fires should always be banked at the front. If banked at the back a large part of the surface of the furnace crown plate is exposed to the cold air, and thereby downward currents are induced in the water within the boilers which may lead to a deposit of sediment on the crown plate.

Recommendation

In new vessels the following suggestions if adopted would eliminate the risk arising from the presence of sediment.

The blow-off pipe should only be used for blowing off and not for filling the boilers. This can be done by fitting a non-return valve on the blow-off pipe, permitting the water to be ejected from the boiler, but preventing its admission through this pipe.

Water for feeding or filling the boilers in port or when the water is muddy should be filtered. This can be attained by a filter (with a locked by-pass for use at sea) being fitted between the donkey pump sea-cock and its suction valve chest. If more than one pump can feed the boilers, each should draw from a tee piece on the bottom of the filter.

From the boiler circulating valve on the donkey pump suction chest the circulating pipe should be connected to the blow-off pipe between the non-return valve above mentioned and the blow-off valve on the boiler. Through this pipe the boilers can be filled by running up from the sea *via* the filter, or the water in them can be circulated when raising steam as may be desired.

Investigation Into Bulkhead Stiffeners—II

Second Class of Bulkheads, Forming Boundaries of Trimming Tanks, Peak Tanks or Deep Ballast Tanks

BY A SPECIAL CORRESPONDENT

We will now consider the second class of bulkheads—those forming boundaries of trimming tanks, peak tanks or deep ballast tanks. These we have noted are subject to stress at frequent intervals and must be designed to carry their load with a reasonable factor of safety. The scantlings are determined in the same way as for the other bulkheads, but with a head equal to the greatest head to which the tank will be subjected. To get a complete comparison of results, we will also obtain the stresses in this bulkhead when subjected to the same head as considered for the second type of bulkhead, i. e., maximum head that can be obtained with vessel still afloat. In this type of bulkheads, the stiffeners must be clipped or bracketed. Below we will consider the clipped type only:

From the tables we find that it is necessary to use a 9-inch by 3½-inch by .45-inch bulb angle.

The above angle has the following characteristics:

Area of section	6.41 square inches.
Section modulus	13.50-inch units.
Moment of inertia	66.10-inch units.
Distance of neutral axis to bulb	4.90 inches.
Distance of neutral axis to heel	4.10 inches.
Weight per foot run	21.8 pounds.

The mean plating thickness will be about .38 inch. We will assume that the width of the functional plating is thirty times the thickness.

This then gives us a section modulus as figured below:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	4.33	9.19	39.79
Stiffener	6.41	4.90	31.41
Sum	10.74	6.63	71.20

$$I \text{ of plate} = 1/12\ Ad^2 = \frac{4.33 \times .38 \times .38}{12} = .05196.$$

$$I_o \text{ of plate} = I + Ad^2 = .05196 + 4.33\ (9.19 - 6.63)^2 = .052 + 28.38 = 28.43\text{-inch units.}$$

$$I \text{ of angle} = 66.10.$$

$$I_o \text{ of angle} = 66.10 + 6.41\ \ (6.63 - 4.90)^2 = 66.10 + 19.19 = 85.29\text{-inch units.}$$

$$\text{Total } I_o = 28.43 + 85.29 = 113.72.$$

$$\text{Then section modulus} = \frac{113.72}{6.63} = 17.15.$$

The required number and size of rivets in end clips is shown in Fig. 5. The polar moment of inertia of this connection is

$$I_p = Ay^2 = .442\ (½ \times 1⅞ \times 2 + 2 \times 2\ 13/16) = .442\ (1.875 + 5.625) = 3.359\text{-inch units.}$$

Then the stress carried by these end connections being limited to 15,000 pounds per square inch, we get the following permissible bending moment:

$$M = \frac{fI}{y} = \frac{15{,}000 \times 3.359}{2.813} = 17{,}911\text{-inch pounds.}$$

This allowable bending moment is only a very small proportion of that at the ends, if these were considered fixed, and in view of this, as before, we can say that the maximum bending moment will be at about 52 percent of the length from the upper end and is found as follows:

The bending moment, if the ends were free, would be:

$M = .126\ Pl$, where $l = 12$ feet, and

$$P = Wshl + \frac{wsl^2}{2}.$$

$$P = 64 \times 2.5 \times 6 \times 12 + \frac{64 \times 2.5 \times 144}{2} = 23{,}040 \text{ pounds.}$$

$$M = .126 \times 23{,}040 \times 12 = 34{,}837 \text{ foot pounds.}$$
$$= 418{,}044\text{-inch pounds.}$$

The actual bending moment, however, is 418,044 — 17,911 = 400,133 inch pounds.

The rules require that the stiffeners be placed upon the water side of the bulkhead. Then in stiffener

$$f_c = \frac{M}{S} = \frac{400{,}133}{17.15} = 23{,}332 \text{ pounds per square inch.}$$

In plating

$$f_t = \frac{My}{I} = \frac{400.133 \times 2.56}{113.72} = 8{,}996 \text{ pounds per square inch.}$$

These stresses are moderate and are not much above what is considered conservative practice. They are below the elastic limit of the material, and only small deflection and sets will be found on test. In warship construction it is usual to limit the stress in bulkhead stiffeners to 20,000 pounds per square inch, but 22,000 pounds is permissible.

As a comparison we can now figure the stresses when this bulkhead is subjected to a head equal to that figured

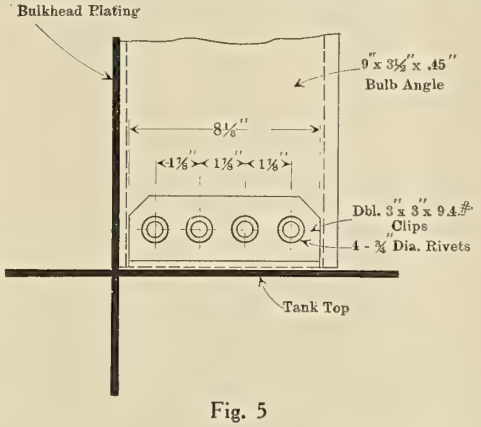


Fig. 5

for the former type. If this head was the maximum possible head under service condition, our size of stiffener would be correspondingly increased, but this head is one only possible in case of accident. The following figures have an interest as a comparison to those derived in the first part of this article.

The bending moment due to this head is, as before, 470,292 inch pounds; hence, since these stiffeners are clipped, the actual moment is 470,292 — 17,911 = 452,381 inch pounds. Then in stiffener,

$$f_c = \frac{M}{S} = \frac{452{,}381}{17.15} = 26{,}377 \text{ pounds per square inch.}$$

and in plating,

$$f_t = \frac{My}{I} = \frac{452{,}381 \times 2.56}{113.72} = 10{,}114 \text{ pounds per square inch.}$$

These stresses also are considered moderate in comparison to those found previously for clipped and free stiffeners.

As before, let the strength of the end connections be neglected and the stress found as if this stiffener were only freely supported; then under design conditions,

$$f = \frac{418{,}044}{17.15} = 24{,}376 \text{ pounds per square inch.}$$

This stress is still moderate and shows that the bulkhead will be safe, even if the clips do not hold the ends of stiffeners rigid.

However, if the maximum head is considered for this condition, the stress is increased to

$$f = \frac{470{,}292}{17.15} = 27{,}428 \text{ pounds per square inch.}$$

Another stress of interest is when the functional plating is neglected. Then under designed conditions, considering clips,

$$f = \frac{400{,}133}{13.5} = 29{,}639 \text{ pounds per square inch,}$$

and neglecting clips,

$$f = \frac{418{,}044}{13.5} = 30{,}966 \text{ pounds per square inch.}$$

The stress in the bulkhead plating is found in the figures below. The first condition will be when the head is to the load waterline.

Pressure due to head of 12 feet = 5.28 pounds per square inch. Load on strip one inch wide is then:

$$5.28 \times l \times (30 - 3.5) = 139.9 \text{ pounds.}$$

Bending moment is:

$$M = \frac{Wl}{8} = \frac{139.9 \times (30 - 3.5)}{8} = 463.8\text{-inch pounds}$$

$$I = 1/12\, Ad^2 = \frac{.38 \times l \times .38 \times .38}{12} = .00457.$$

$$\text{Then } f = \frac{My}{I} = \frac{463.8 \times .19}{.00457} = 19{,}281.$$

While this figure is not the true stress, as explained before, it is an indication that the thickness of the plating is ample.

If the maximum head is considered, we get a pressure due to head of 13.5 feet = 5.94 pounds per square inch.

Then the load will be:

$$5.94 \times l \times (30 - 3.5) = 157.4 \text{ pounds.}$$

The bending moment is:

$$M = \frac{Wl}{8} = \frac{157.4 \times (30 - 3.5)}{8} = 521.4\text{-inch pounds}$$

$$\text{Then } f = \frac{My}{I} = \frac{521.4 \times .19}{.00457} = 21{,}678 \text{ pounds per square inch.}$$

The final figures to obtain are the shear stresses. As before, let us take the shear at two feet above the bottom of the bulkhead. The shear at this point is for the designed head.

$$F = \frac{Wshl}{2} + \frac{2\,Wsl^2}{6}$$

$$= \frac{64 \times 2.5 \times 6 \times 10}{2} + \frac{64 \times 2.5 \times 100 \times 2}{6}$$

$$= 6{,}000 + 5{,}333 = 11{,}333 \text{ pounds.}$$

$$q = \frac{F}{I}\, my,$$

where the terms have the same meaning as previously indicated. Then

$$q = \frac{11{,}333}{113.72} \times 4.33 \times 2.56 = 1{,}103 \text{ pounds per inch depth.}$$

Rivets are, say, ¾-inch diameter spaced 5½ diameters center, or, say, 4⅛-inch centers.

Then the stress per rivet is 1,103 × 4½ = 4,964 pounds, and stress per square inch is

$$\frac{4{,}964}{.442} = 11{,}231 \text{ pounds.}$$

This stress is considered moderate, but requires careful workmanship in drilling and riveting up to insure that all rivets are sound and can carry this stress.

The total shear on the clip rivets is found as follows:

$$F \text{ at bottom} = \frac{64 \times 2.5 \times 6 \times 12}{2} + \frac{2 \times 64 \times 2.5 \times 144}{6}$$

$$= 5{,}760 + 7{,}680.$$

$$= 13{,}440 \text{ pounds.}$$

This shear is carried by four ¾-inch diameter rivets in double shear, or the stress in each rivet is

$$P = \frac{13{,}440}{1.8 \times 4 \times .442} = 4{,}226 \text{ pounds per square inch.}$$

Then real stress

$$P = \sqrt{P^2 + q^2} = \sqrt{4226^2 + 15{,}000^2}.$$

$$= 15{,}550 \text{ pounds per square inch.}$$

The third type of bulkhead to be considered is that of the first class when applied to passenger vessels. Here the head will again be taken to the bulkhead deck.

Considering first the unclipped stiffeners, since l = 12 feet and the head is 13.5 feet, we find from the table of scantlings that the nearest section obtainable in the United States to that required is an 8½-inch by 3-inch by .475-inch bulb angle.

This angle has the following characteristics:

Area of section	6.09 square inches.
Section modulus	12.00-inch units.
Moment of inertia	54.6 -inch units.
Distance of neutral axis to bulb	4.55 inches.
Distance of neutral axis to heel	3.95 inches.
Weight per foot run	20.7 pounds.

The mean thickness of plating will again be about .32 inch and the functional width will be taken at 30 t.

The figures for the section modulus will be as follows:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	8.66	26.59
Stiffener	6.09	4.55	27.71
Sum	9.16	5.93	54.30

$$I \text{ of plate} = 1/12\, Ad^2 = \frac{3.07 \times .32 \times .32}{12} = .0262\text{-inch units.}$$

$$I_o \text{ of plate} = .0262 + 3.07\ (8.66 - 5.93)^2 = .03 + 22.87 = 22.90\text{-inch units.}$$

$$I_o \text{ of angle} = I + Ad^2 = 54..6 + 6.09\ (5.93 - 4.55)^2 = 54.6 + 11.57 = 66.17\text{-inch units.}$$

$$\text{Total } I_o = 22.90 + 66.17 = 89.07\text{-inch units.}$$

$$\text{Then } S\,\frac{I_o}{y} = \frac{89.07}{5.93} = 15.02\text{-inch units.}$$

The bending moment, as before, is 470,292 inch pounds, and, if pressure is on calking side,

$$f_t = \frac{470{,}292}{15.02} = 31{,}311 \text{ pounds per square inch.}$$

$$f_c = \frac{470{,}292 \times 2.89}{89.07} = 15{,}259 \text{ pounds per square inch.}$$

This maximum stress is considered too high in view of the fact that the safety of the passengers may depend upon this bulkhead.

If the functional plating is omitted, the stress will be:

$$f_t = \frac{470{,}292}{12.0} = 39{,}190 \text{ pounds per square inch.}$$

The shear stress in rivets between plating and stiffener, figured for two feet above the bottom, will be as follows:

F (as before) = 11,333 pounds.

Then $q = \frac{F}{I_o} my = \frac{11{,}333}{89.07} \times 3.07 \times 2.73 = 1{,}066$ pounds per inch depth.

Rivets ¾ inch diameter, 7 diameters pitch, or 5¼-inch centers.

The stress per rivet is $1{,}066 \times 5{,}25 = 5{,}597$ pounds.

Stress per square inch of rivet is $\frac{5{,}597}{.442} = 12{,}663$ pounds.

This stress is fairly moderate, but a trifle high.

The stress in plating is as found for the first type of bulkhead.

The next case to figure is that where the stiffeners are clipped, and, since l and h are the same, we find that the nearest section rolled in this country to that called for in the table of scantlings is an 8½-inch by 3-inch by .40-inch bulb angle. This angle has the following characteristics:

Area of section	5.34 square inches.
Section modulus	10.8 inch units.
Moment of inertia	48.9 -inch units.
Distance of neutral axis to bulb	4.54 inches.
Distance of neutral axis to heel	3.96 inches.
Weight per foot run	18.1 pounds.

Clips will have four ¾-inch diameter rivets.

Weight of plating same as above.

The figures for new section modulus with a width of functional plating of 30 t are as follows:

Name	Area	Dist. of C. G. from Bulb of Angle	Moment
Plate	3.07	8,66	26.59
Stiffener	5.34	4.54	24.24
Sum	8.41	6.04	50.83

I of plate as above = .0262-inch units.

I_o of plate $I + Ad^2 = .03 + 3.07\ (8.66 - 6.04)^2 = .03 + 21.06 = 21.09$-inch units.

I_o of angle $= I + Ad^2 = 48.90 + 5.34\ (6.04 - 4.54)^2 = 48.90 + 12.01 = 60.91$-inch units.

Then total $I_o = 21.09 + 60.91 = 82.00$ inch units,

and

$$S = \frac{I_o}{y} = \frac{82.00}{6.04} = 13.57 \text{ inch units.}$$

The polar moment of inertia of the riveting in the clips is as found before for the deep tank bulkhead and is

$I_p = 3.359$-inch units.

Then the permissible bending moment is, as before,

$$M = \frac{fI_p}{y} = 17{,}911 \text{ inch pounds.}$$

The free bending moment, as before, is 470,292 inch pounds, and the actual bending moment in this case is

$470{,}292 - 17{,}911 = 452{,}381$ inch pounds.

Then, if the pressure is on the calking side,

$$f_t = \frac{452{,}381}{13.57} = 33{,}336 \text{ pounds per square inch.}$$

$$f_c = \frac{452{,}381 \times 2.78}{82.00} = 15{,}337 \text{ pounds per square inch.}$$

It will be seen that this maximum stress is a considerable higher one than is good practice, especially in passenger vessels.

If the tieing-in effect of the clips is neglected, the maximum stress becomes:

$$f_t = \frac{470{,}292}{13.75} = 34{,}203 \text{ pounds per square inch.}$$

This shows how important it is to obtain the highest grade workmanship on the clips, because if any slip occurs the bulkhead is stressed beyond the elastic limit. Assume that the plating is poorly riveted and does not act with the stiffener; then if the clips hold firm the maximum stress will be

$$f_t = \frac{452{,}381}{10.80} = 41{,}887 \text{ pounds per square inch.}$$

This points out that the connection between the plating and stiffener should be ample. The rules specify a spacing of seven diameters, and this, it is contended, is too large. If the fixing effect of the clips is also neglected, the maximum stress becomes

$$f_t = \frac{470{,}292}{10.80} = 43{,}546 \text{ pounds per square inch.}$$

The above figure emphasizes the fact that workmanship is a very important item in keeping stresses down in a bulkhead.

The shearing stress in rivets between plating and stiffener two feet from the bottom is

F (as before) = 11,333.

Then $q = \frac{11{,}333}{82.00} \times 3.07 \times 3{,}62 = 1{,}161$ pounds per inch depth.

Then stress per rivet is $1{,}161 \times 5.25 = 6{,}095$ pounds.

Stress per square inch of rivet is $\frac{6{,}095}{.442} = 13{,}789$ pounds.

The shearing stresses in the clips at the bottom is as below:

F at bottom (as before) = 14,880 pounds.

This shear is carried by four ¾-inch diameter rivets in double shear, or the stress in each rivet is

$$P = \frac{25{,}920}{1.8 \times 4 \times .442} = 4{,}679 \text{ pounds per square inch.}$$

q, due to bending, was assumed at 15,000 pounds per square inch; then the real stress is

$$P = \sqrt{P^2 + q^2} = \sqrt{4{,}679^2 + 15{,}000^2}.$$
$$= 15{,}720 \text{ pounds per square inch.}$$

This shear stress is high, but it is in proportion to the other stresses already found. To reduce same it would be necessary to cut down the bending moment resisted by the clips and hence increase the stress in the stiffener.

The stress in the plating will be as found for the first type of bulkhead.

To sum up our figures the table on the next page has been prepared, giving the actual maximum stresses as found under the various conditions assumed above.

The conclusions that can be drawn from the above calculations are that the stresses are uniformly high and

TABLE OF RESULTS

Type and Class	Cargo Ship Bulkheads, Unclipped	Cargo Ship Bulkheads, Clipped	Deep Tank, Clipped	Passenger Vessels, Unclipped	Passenger Vessels, Clipped
Total section modulus.	12.33	11.05	17.15	15.02	13.57
Maximum stress, design head.....	38,142	41,212	23,332	31,311	33,336
Maximum stress, maximum head.....	38,142	41,212	26,377	31,311	33,336
Maximum stress, no functional plating considered, design head	47,029	50,612	29,639	39,190	41,887
Maximum stress, no clips considered, design head.....	.....	42,560	24,376	.....	34,203
Maximum stress, no clips and no plating considered, design head	.....	53,442	30,966	.....	43,546
Shear in rivets to plating, design head	13,300	15,023	11,231	12,663	13,789
Shear in clip rivets, design head.....	.....	16,250	15,550	.....	15,720
Stress in plating, design head.....	31,707	31,707	19,281	31,707	31,707

MATERIAL NOTES

	Pounds per Square Inch
Minimum tensile strength of shapes.....	58,000
Minimum yield point of shapes.....	29,000
Maximum tensile strength of shapes.....	74,000
Maximum yield point of shapes.....	37,000
Mean tensile strength of shapes.....	66,000
Mean yield point of shapes.....	33,000

that too much credit is apparently given to the end fixing property of clips.

As regard free stiffeners, i. e., stiffeners with no end connections, we find that for ordinary bulkheads the stress as figured is beyond the mean yield point of the material—in fact, beyond the maximum yield point. This is not considered good practice because a stress of this magnitude may cause failure in the bulkhead at a critical time and consequent loss of the vessel. As seen in the above figures, even this stress can be increased when coupled with a poor quality of workmanship. In the bulkheads for passenger vessels we find a lower stress, one which is only slightly in excess of the minimum yield point of the material. Considering, however, the possible loss in life resulting from the failure of these bulkheads at a critical time even this stress is too high. The remark made above concerning workmanship applies in this.

Regarding the clipped stiffeners, it is found we have to deal with even greater stresses in this case, except in connection with the deep tank bulkheads. A stress of 43,000 pounds per square inch is considered abnormal and it is certain that, if the workmanship was not absolutely perfect, this bulkhead would fail. The stress of 33,000 pounds per square inch for the passenger vessels' bulkhead is more moderate, but is just equal to the mean yield point of the material. From the calculations for shear in the clip rivets, it is seen that this stress is more moderate than the other stresses involved and it is possible by increasing this shear to pull the stress in the stiffener down to the point where it is equal to that in the unsupported stiffener. This change in balance of the stresses would, however, make it even more necessary to obtain the most perfect workmanship possible in fitting and riveting these clips. Another method, or one to use in conjunction, would be to increase the size of the rivets in the clips to ⅞-inch diameter. By doing these two things, we could no doubt maintain the stress in the clipped and unclipped stiffener the same.

It is questioned, however, whether in practice it is possible to fit these clips with sufficient rigidity to prevent slight slips or spring when stressed. A movement no matter how slight would destroy the end fixing property of our clips, and increase again the stress in the stiffeners to beyond the yield point.

Stresses beyond or equal to the elastic limit, it must be borne in mind, should be avoided, because they are, so to speak, in "no man's land" and success or failure is difficult to foretell. In view of this, it would be excellent practice to consider even clipped stiffeners as unsupported, unless, as suggested, the riveting is increased, in fixing upon allowable stresses.

In considering the question of clips, it should be remembered that labor and not material is the controlling item in the cost of the hull and it is considered that the cost of fitting clips is rather in excess of the cost of increased material necessary to put into the stiffeners, if they are unclipped. In the present day labor and time must be reduced to a minimum, and the slight increase in weight involved in the larger stiffeners is more than counterbalanced by the saving in time and cost. This same argument applies to brackets.

Another thing brought out in the above figures is that the strip of functional plating is a most important item. The riveting between the stiffener and plating is very highly stressed in all except the deep tank and passenger ship bulkheads. The classification rules call for a pitch of these rivets of 7 diameters. The United States Navy practice is six diameters, and it is now here suggested to reduce this to five and one-half diameters for one-third the length at each end and six diameters in the middle third. This would reduce these shear stresses and insure proper re-enforcement for the stiffener itself. The effect of this functional plating, it is seen by the above figures, is greater than that of end clips.

It is further suggested that the following stresses be considered as a maximum in these two types of bulkheads, and that in each design the scantlings fixed be not accepted without an investigation into the stresses:

Cargo boat bulkhead stiffeners' maximum stress equals 30,000 pounds per square inch.

Passenger vessel bulkhead stiffeners' maximum stress equals 28,000 pounds per square inch.

Shear in each case in plating connections and clip rivets maximum equals 12,000 pounds per square inch.

In connection with the deep tank bulkheads, the stresses found appear satisfactory, the maximum stress under design head being only 23,550 pounds per square inch. The shear in the rivets is only 11,000 pounds, and this decrease in stress over that shown on the other bulkheads is because the spacing of rivets has to be reduced at the ends. The shear stress in clip rivets appears a little high. The limiting stresses in this case should be:

Deep tank bulkhead stiffeners, maximum stress 24,000 pounds per square inch.

Shear in plating connections and clip rivets, maximum 12,000 pounds per square inch.

In deep tank bulkheads the American Bureau of Shipping requires that the stiffeners be clipped or bracketed. As long as a sufficient section modulus is introduced, the author fails to see why it should not be permissible to fit stiffeners without end attachments. As before stated, it is believed this would mean a saving in labor and cost, as well as time.

A final word in connection with permissible stress in stiffeners. Navy practice is 20,000 to 22,000 pounds per square inch. In this case, as well as in deep tank bulkhead, these structures are subjected to a static test to test strength, deflection and tightness. This is a very satisfactory test on the workmanship, and it might be said about the only possible one. In the other type of bulkheads, although greater stresses are permitted, no means is available for testing the workmanship. True, they are

(*Continued on page* 561.)

Keeping the Engine Room Log

Data Recorded in the Log—Its Use in Determining Economy of Vessel and Locating Wastes

BY W. E. DAVIS

AT this time, when there is so much speculation regarding the future of the American merchant marine, the one consideration brought out in all discussions is efficiency—efficiency of production and efficiency of operation. Stress has been laid on the idea of economical machinery, not only in regard to operating cost, but also as to the space occupied by machinery and fuel. Economy of fuel means increased cargo space. In some of the standardized turbine gear drives developed for merchant ships during the war, we have plants which are compact and operate at efficiencies far above the old reciprocating engine layout.

Duty of the Chief Engineer

The original design and installation of propelling machinery may be efficient, but unless the plant is kept in this condition and attention is given to the daily performance, it is impossible to prevent needless operating losses. This is squarely up to the chief engineer. Navy regulations require that numerous logs and records be kept regarding the detailed operation of the engineering department aboard ship. Some of the same information has been required aboard ships operated by the Naval Officers' Training School and the Shipping Board.

In the past there has been a great variation in the requirements of various privately owned steamship lines. Disregarding previous practice, as a matter of routine there are certain data which are simple to record, and a daily analysis of which will give the chief engineer valuable information regarding the economy of his plant and enable him to locate waste. Just to keep machinery running and bearings cool is not enough—the whole plant must be run efficiently. In the last analysis, the prime consideration is the cruising radius for a definite cost of fuel. At a certain fixed speed the fuel expenditure per twenty-four hours, making allowances for weather conditions, should be a given amount, depending on what auxiliaries are in operation.

Navy Log Sheet

Fig. 1 shows the rough log sheet commonly used in the Navy and which, with slight variations to suit the type of ship, might be used in the merchant marine.

The first thing to do is to obtain the water rate of the various prime movers and auxiliaries in the ship when operating under normal conditions, as well as the rate of evaporation of the boilers. It is not necessary to go into exhaustive tests in order to make this analysis valuable.

The drains from the evaporators may be segregated and run to a spare tank for the period during which the amount of water is to be measured. Thus the number of gallons of water per pound of steam may be determined. The exhaust from lighting sets and other auxiliaries may be run separately to the auxiliary condenser for a period during which all other exhaust is run to the main condenser. The condensate from the auxiliary condenser is then run to a separate tank, where it may be measured in order to determine the water rate of these auxiliaries.

The main turbines will use a definite amount of steam, depending on pressure and nozzle openings. Napier's formula can be used to determine the amount of steam used by the turbine:

$$\frac{\text{Absolute pressure} \times \text{area of nozzle in inches}}{70} = \text{pounds of steam per second.}$$

The circulating pump will deliver a definite number of gallons per minute, depending on its speed.

It is thus possible to obtain a standard of what each piece of equipment should use. Also, in the case of a new ship, the manufacturer of the various machines can furnish data regarding steam consumption at various speeds and loads.

Analyzing the Log Sheet

How this information may be analyzed for use is the next point to be considered. The noon coal report comes in. It is found that a certain amount of fuel for the given speed has been used. In this instance the consumption is greater than usual. In the log there is a record of the machinery in operation during the past twenty-four hours and the conditions under which it has operated. This information, combined with the water rates which you have obtained, can be summarized as shown in the following table, assumed for a turbine gear drive cargo ship:

Unit	Hours in Operation	Nozzle Opening	Pressure, Absolute, Pounds per Square Inch	Pounds Steam per Hour	Pounds, Total
Main turbine.....	24	2.238	160	18,414	441,936
Circulating pump.	24			1,330	31,920
Condensate pump.	24			300	7,200
Air ejectors.....	24			440	10,560
Lighting set*.....	24			936	21,664
Main feed pump†.	24			500	12,000
Bilge pump	8			400	3,200
Flushing pump‡..	24			300	7,200
Evaporators‡	20				32,000
					567,680

* Average load, 8 kilowatts.
† Average, 30 strokes per minute.
‡ 200 gallons per hour; total, 4,000 gallons at 8 pounds steam per gallon.

The coal expenditure for the twenty-four hours has been thirty-one tons, which, with an evaporation of nine pounds water per pound of coal, would represent 624,960 pounds steam, although our total from the machinery is 567,680.

Check on Steam Consumption

Now, for a further check, it is found that the circulating pump has averaged 2,500 gallons per minute and that the temperature rise has been 17.5 degrees, which, from the formula,

$$\text{Pounds of steam per hour} = \frac{\text{degrees' rise in temperature (gallons per minute} \times 500)}{940}$$

gives us 23.165 pounds per hour, equals 555,960 pounds per twenty-four hours. This checks with the summary of machinery and would indicate that the fireroom is the place to look for the trouble.

On the other hand, if the temperature rise had been 20 degrees, with 2,500 gallons per minute circulating water, then the steam per hour, by the above formula, would be 26,596 pounds, a total of 638,304 pounds for the twenty-four hours. This figure checks with the amount of fuel used, and would indicate that the place to look for trouble is in the engine room and not always in the boiler room.

Of course, operating conditions vary, but it is possible for each engineer to work out a schedule similar to the one outlined and to apply it to his individual requirements. He will find that the knowledge gained regarding his plant is well worth the time necessary for this daily check.

Naval Construction During the War*

Destroyers and Flotilla Leaders—Patrol Boats—Sloops and Mine Sweepers—Submarines—China Gunboats—Air Craft

BY SIR EUSTACE TENNYSON D'EYNCOURT, K. C. B.

To give a complete account of the development of the design and construction of our destroyers and flotilla leaders during the war would mean a very long paper, and I think, therefore, I must refer only to the tables and plans which I give. These vessels have gradually increased in size and power, and war requirements have continually added to the weights which they have had to carry, including considerable more fuel, heavier armament, both of guns and torpedoes, depth charges, larger bridges, and other additions. In fact, some of the ships which before the war were 900-ton vessels, now carry an additional 100 tons, which, of course, is a very heavy handicap to these vessels when expected to maintain a high speed. The introduction, however, of the geared turbine has added enormously to the efficiency of the machinery and propellers; the lower revolutions which can be introduced with the gearing enabling us to adopt much more suitable propellers, in addition to giving a greater economy of fuel.

Destroyers and Flotilla Leaders

During the war, nearly 300 destroyers and flotilla leaders, which are simply a larger form of destroyer with improved accommodation, have been added to the fleet, and the whole class of these vessels has been called upon to do continuous work in heavy weather. They have come through the ordeal with extraordinarily few breakdowns of machinery or other parts of the ship, while the duties they have been called upon to perform in combating the submarines, convoying, etc., have been most continuous and varied.

Most of the designs have been got out at the Admiralty, but certain others, including some destroyers built for foreign countries and taken over by the Admiralty, have been evolved by the builders, Messrs. Thornycroft, Yarrow, White, Fairfield, J. Brown, and Hawthorne Leslie.

Numbers of these vessels also have been built by firms who had never built a warship before, but the work turned out by them has fully met the Admiralty requirements.

The flotilla leaders, with a deep load displacement of about 2,000 tons and an armament of four 5-inch or 4.7-inch guns and with their very high speed, might well be described as fast scouts or third-class cruisers.

Patrol Boats

Patrol boats naturally follow the torpedo-boat destroyers, as they were specially designed to relieve the destroyers of some of their strenuous duties of patrolling and submarine-hunting and escort work. The conditions were that they had to be as small as possible, consistent with keeping the sea in all weathers. They had to be fast enough to run down submarines, and they had to have shallow draft and all top-hamper kept low to prevent their being seen at a distance. Economy of fuel was also an important feature, and it was desirable to have them built of mild steel rather than high tensile steel, to avoid dril-

* From a paper read before the Institution of Naval Architects. Concluded from the July issue.

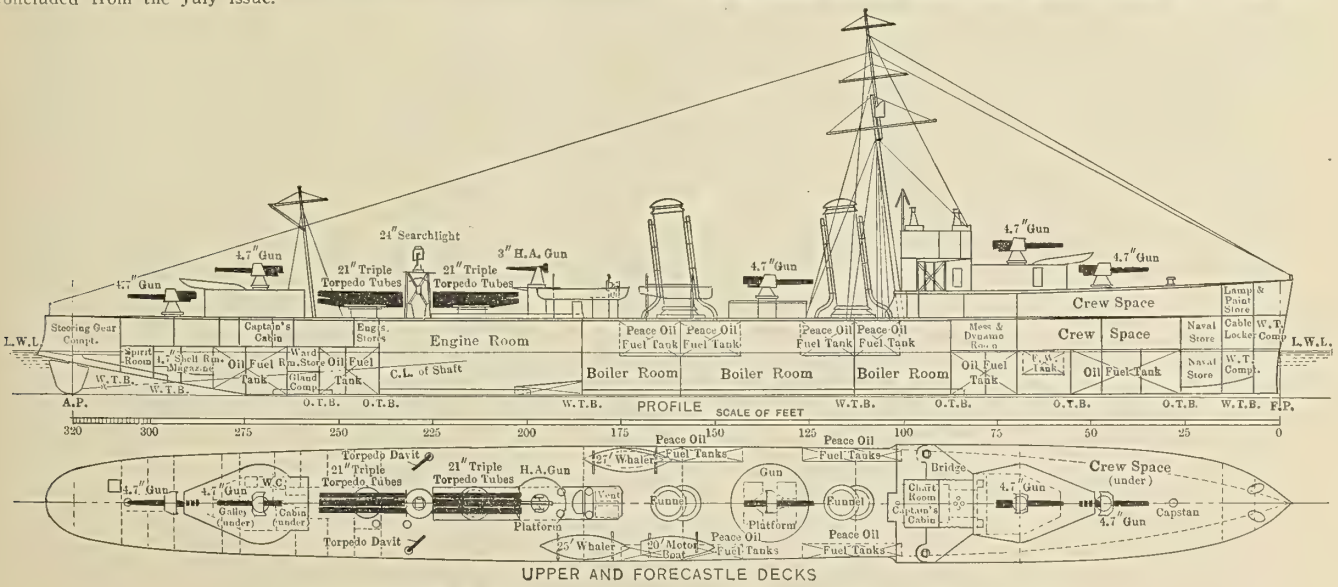


Fig. 9.—H. M. S. *Scott* Class, Flotilla Leader. Admiralty Design (1916)

ling and special workmanship. They were provided with a special hard steel ram, with which a considerable number of enemy submarines were sunk without damaging the patrol boat. The various features were combined in a vessel of something under 600 tons, with geared turbine engines of 3,800 horsepower, giving a speed of over 22 knots. with 330 revolutions of the propellers. The boats had large rudder area and were cut up aft, so that they could turn very quickly upon the enemy—a most important feature for ramming purposes. They proved very valuable boats, and did a great deal of work against the submarines in all weathers. They were armed with only one 4-inch gun, mounted in a commanding position in the forward superstructure, one 2 pounder and two 14-inch torpedo tubes, and later it was arranged to carry depth charges.

Several of these vessels were mined, and although the damage they sustained was very severe, they kept afloat and were repaired.

We had the honor of being asked to design and provide some vessels of this type for the French government, and eight of these were built for that purpose and armed with somewhat heavier armament than our own ships. I understand that the French government was very well satisfied with the vessels.

In addition to this, at a later stage, for sweeping in shallow water, some paddle mine-sweepers were designed at the Admiralty, of which particulars are given in the table. These were 15-knot boats, with draft just under 6 feet 9 inches. They did good work, but were of course not such good sea-boats as the sloops. As there was some

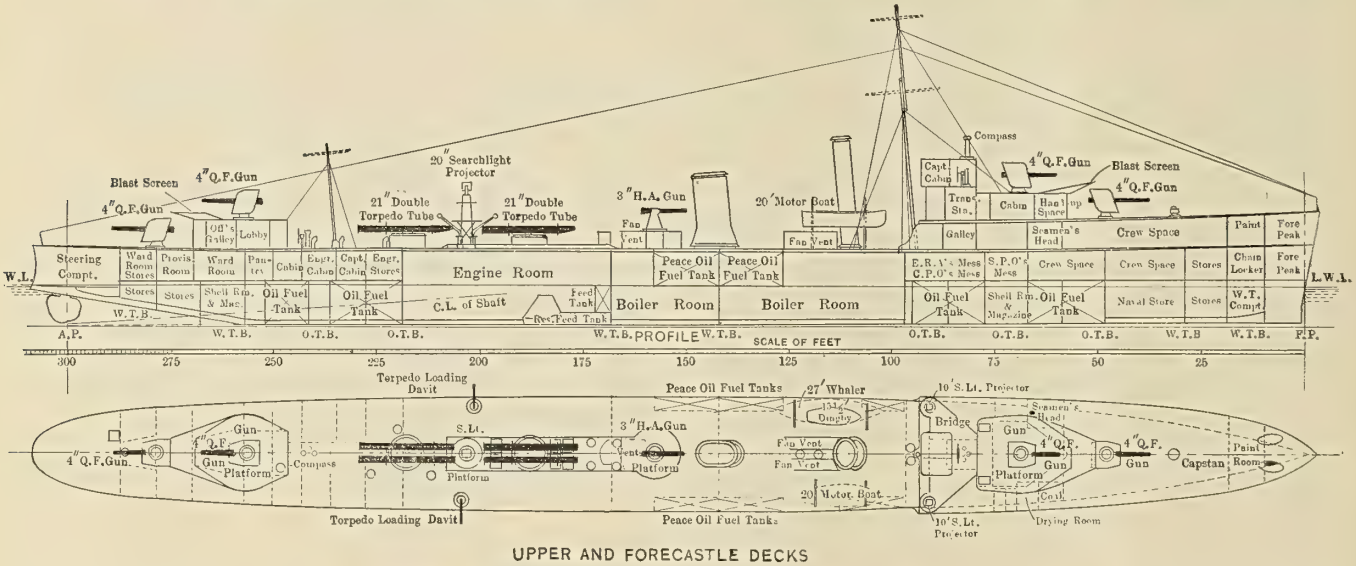


Fig. 10.—H. M. S. *Vectis*, Admiralty Design, "V" Class Destroyer

Their cost was, of course, considerably less than that of a modern destroyer.

Some of these boats were afterwards disguised to look like small mercantile craft—a device which also proved quite successful.

On the outbreak of the war it became clear that there would be a great demand for mine-sweeping vessels. A good many coasting and cross-Channel steamers were taken up for this purpose, but more were required, and it was decided in December, 1914, to build twelve single-screw ships of simple design to this end. With the view of hastening construction, it was decided to adopt mercantile practice as far as possible in both hull and machinery. The vessels, although of very fine form, were built of simple construction and under Lloyd's survey. The boilers were of ordinary Scotch type, and single-screw machinery was provided.

In the end, nearly 100 of these vessels were built, and the armament, which at first was two 12-pounders, was subsequently increased to two 4-inch or two 4.7-inch guns. A great many of these vessels were built in about six months from the order, and the first thirty-six averaged twenty-five weeks in building. They proved excellent sea boats, and were used not only for mine-sweeping, but also for submarine work, especially for convoying. At later stages some of these vessels were disguised as ordinary merchant ships. They were economical steamers and were able to attain a full speed of 17 knots, with a horsepower of about 1,800 to 2,000 in the earlier, which was increased to 2,500 in the later, vessels.

danger of mines getting under the paddles, a further design of twin-screw mine-sweepers was got out, of which particulars are also given in the table. These were vessels of about 800 tons and about 16 knots speed.

As it would make the paper rather too long, I am only giving a table of the particulars of the designs of submarines, but a very large number of these vessels have been added to the fleet during the war, and some twelve different types, some embodying very special requirements and all being improvements on their predecessors. It is interesting to note that we produced the fastest internal-combustion engined submarine in "*J*" class, which attained a speed of over 19 knots. As a still higher speed was wanted for fleet work, the "*K*" boats were designed with a surface speed of 24 knots. To arrive at this it was necessary to go to steam and special arrangements, of course, had to be made for shutting down watertight the funnels, etc. However, all these difficulties were overcome and the boats proved very successful.

It is an interesting point about these vessels also that, besides the steam turbines for full speed on the surface and the electric drive when under water, they are provided with a Diesel engine for use just before diving or immediately after breaking surface, in order to hasten the time of diving or of getting away quickly after coming up. The transmission from the Diesel engine was through the electric motors, so that these vessels had not only geared turbines for the steam drive, but they also had electric transmission with a Diesel engine and electric battery drive when under water.

Although the Germans had the advantage of more power per cylinder in their Diesel engines, we produced faster surface boats, faster underwater boats, and more heavily-armed boats than they.

M.1 submarine, of which some account and illustrations have already appeared in the press, was a monitor submarine armed with a 12-inch gun; she was an experimental boat.

"China" Gunboats

I should not omit to mention the two classes of so-called China gunboats, designed by Messrs. Yarrow. The smaller of these vessels, 120 feet long and of about 100 tons, was constructed in this country in such a way that the parts could be sent out to Abadan, where they were assembled, and the vessels re-erected and completd under the supervision of the Admiralty officers. Some of the larger boats, 230 feet long and of 645 tons, were completed here and went out to Mesopotamia, where all of them were of the greatest service in that campaign.

It is impossible to mention all the small craft built, but most useful work was done by motor launches and many other types.

Other Auxiliary Craft and Aircraft Carriers

We were called upon at the Admiralty to design many other auxiliary craft—notably some fast fleet oilers which were able to carry 5,000 tons of oil and had a speed of 15 knots. We also designed a great number of special smaller craft for all purposes, and we had to take over and modify, sometimes very extensively, a number of merchant ships for various purposes.

Probably the most important modifications were those made to vessels taken over and converted into aircraft-carriers, including *Campania, Ark Royal, Engadine, Riviera,* etc. I have already alluded to the *Furious,* but one of the *Raleigh* class has also been converted into an aircraft-carrier, and is now named *Vindictive.* The *Argus* was originally built as a passenger mail ship of 20 knots and was taken over and converted into an aircraft-carrier with complete flush deck, the funnels being carried aft in long horizontal ducts, discharging the smoke astern. The *Eagle,* alluded to above, is also being converted into a large aircraft-carrier with a somewhat different arrangement; but it would take too long to go into any detailed account of these ships. There is no question that aircraft-carrying will gradually become more important for the fleet.

Altogether during the four years some 2,000,000 tons have been added to the Navy, at a cost probably between £250,000,000 and £300,000,000 sterling.

Reference to the navy estimates show that the aggregate sum spent during the four years before the War on new construction amounted to approximately £60,000,000.

Besides purely ship design and construction, up till the autumn of 1917, as Director of Naval Construction, I was responsible for the rigid airship designs, to which all our existing rigids have been constructed; the responsibility for this branch was in 1917 transferred to a special Airship Production Department, but officers of the Royal Corps of Naval Constructors transferred to the new department continued the work they had been doing on airships.

The Ports of Trieste and Fiume

With the Italian occupation of Trieste, it is of interest to note that this city is the largest and most important port of the Adriatic. In 1913, for instance, the total movement of navigation in the harbor of Trieste amounted to 5,480,074 tons, representing 57.3 percent of the maritime movement of all that part of the Adriatic coast which has been included in Austria-Hungary.

Fiume, after Trieste, is the most important port of the eastern Adriatic, and its traffic showed considerable development in the last few years before the war. The tonnage discharged increased from 1,681,151 tons in 1900 to 2,564,665 tons in 1912.—*Commerce Reports.*

Trials of the Freighter Diablo

ALL ships constructed for the United States Shipping Board are subjected to rigid acceptance trials arranged by the division of operations of the Board. A typical series of trials which gave good results was recently carried out on the freighter *Diablo,* the first ship built by the Pacific Coast Shipbuilding Company, of San Francisco, in their yards at Suisun Bay, Cal. First a six-hours' dock trial was held to determine that all machinery and auxiliaries were running smoothly. The ship was then made ready for a six-hours' full power run with part of her cargo. This run was made in Suisun, San Pablo and San Francisco bays. After its successful completion, the ship was put into dry dock at the Union plant of the Bethlehem Shipbuilding Corporation, where the hull was painted so that the ship would be in condition for sea immediately after her standardization trials. In order to have the normal draft necessary for these trials, and to waste no time in starting on her maiden voyage after their completion, her entire cargo for Hong Kong and Indian ports was loaded at a berth of the Pacific Mail Steamship Company, under whose flag she sails.

At the time of sailing her mean draft was 24 feet 11½ inches, gross tonnage registered at the custom house 6,103.46, and net tonnage 4,573. The deadweight cargo capacity of 9,683 tons was actually about 300 tons more than required by the specifications. Of this capacity, 240 tons consisted of water, 1,664 tons of fuel oil, 60 tons of ship stores, 90 tons of boiler water, 75 tons of dunnage, and about 7,500 tons of freight.

The average speed for the four standardization runs made between San Francisco and Point Reyes, a distance of 21.75 miles, was 11.06 knots; the average revolutions per minute of the propeller, 89.35; the fuel consumption per knot per hour at a speed of 11 knots, 0.92 barrels of oil; total consumption per hour, 10.1 barrels of oil.

The speed of 11.06 knots attained is rather exceptional for a fully laden ship of the *Diablo* type, and the fuel consumption is well within the ordinary average.

Investigation Into Bulkhead Stiffeners

(*Continued from page* 557.)

often subjected to a hose test, but this is merely local pressure applied to test the tightness, and no stresses of any magnitude are developed.

In general, it is engineering practice to design untested parts with a larger factor of safety than tested parts in order to feel sure that they will not fail in service. In our bulkheads, it is seen, we do just the opposite, and in view of our "non-engineering" procedure it would seem best to limit our stresses to the figures given above and avoid the risk of failure. A ship and its cargo or passengers is a fairly valuable article these days, or, in fact, at any time.

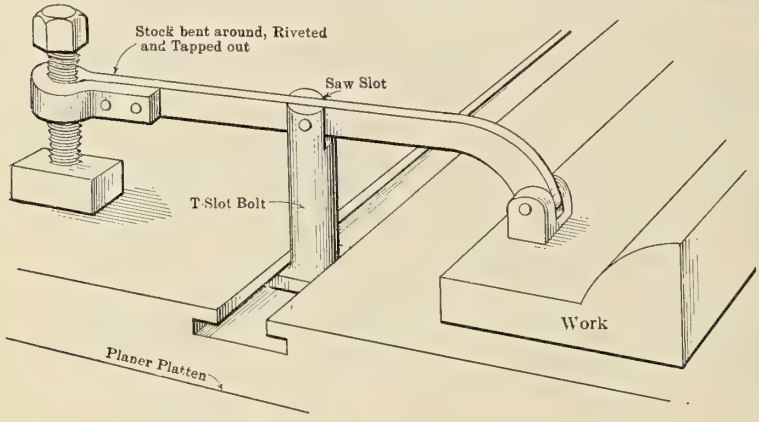
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Handy Planer Clamp

This simple type of planer clamp was evolved by a planer hand to supply a quick-acting clamp for holding special parts, of which he had a quantity to machine. He made up a set of eight of these clamps, and speeded up the



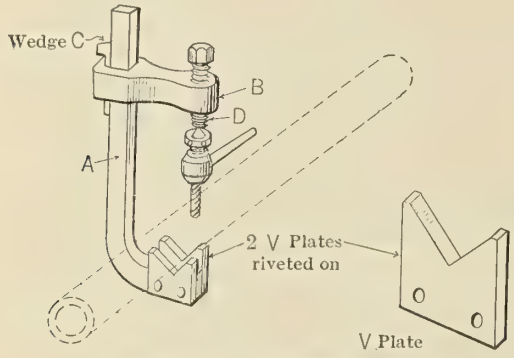
Quick-Acting Clamp for Use on Planers

work of setting up considerably. The drawing shows the clamp in detail. The bolts were ⅞-inch and the clamp arm ⅜- by 1-inch stock. The end in which the adjusting screw is used is formed by bending the stock around in a small circle, riveting the two parts and then tapping out.

MACHINIST.

Pipe Drill Post

I have recently made several sizes of the type of pipe drill post or old man shown in the sketch. I designed this



"Old Man" for Drilling Pipe

simple affair to meet the need of a light yet durable tool.

The upright *A* is of ½ by 1-inch bar with two *V*-plates, such as shown in the detail sketch, riveted to the lower curved end. The jaws are serrated to prevent slipping. The crosshead *B* is forged and the slot for the upright drilled and filed, one end being slightly tapered to take the wedge key *C*. The screw *D* is cup-pointed and case-hardened.

The rig is very easy and cheap to make. W.

Cruiser Stern on Standard G-Type British Vessels

The accompanying illustration will be of interest to readers of MARINE ENGINEERING, as it shows the "cruiser"



Cruiser Stern of the *Nowshera*

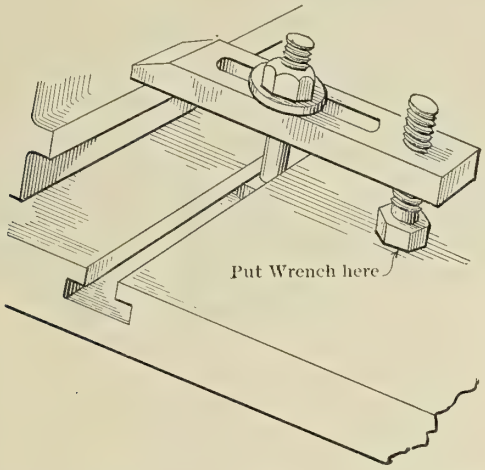
stern of the British steamship *Nowshera,* which is typical of the new standard *G*-type freighters built in Great Britain. The *Nowshera* has a length of 450 feet, a beam of 58 feet 3 inches, a molded depth of 37 feet, and a displacement of about 11,000 tons at the load waterline.

New York. T. J. SMITH.

Unique Machine Strap

Those who operate a drill press or milling machine will appreciate the novel strap that is shown herewith. With the old plain U-shape strap it is always necessary to hunt up blocking to use under the outer end of the strap, and not always can one find just the right thickness of blocking, so washers, etc., have to be hunted up. This strap, designed by a practical shop machinist, does away with that trouble, for the strap is made from steel bar stock with a slot in its center for the regular holding

down bolt. A bolt hole is drilled and tapped in the outer end of the strap to take an adjusting bolt. In setting up



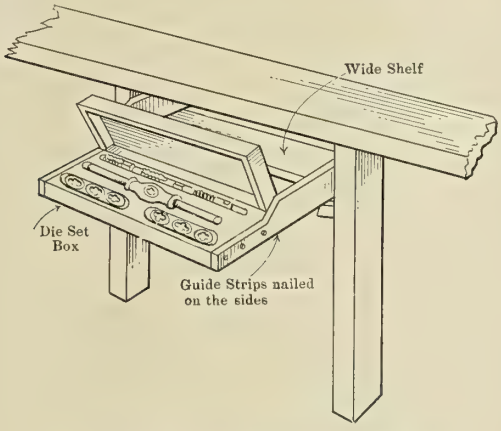
Strap for Holding Work on Drill Press or Milling Machine

work all that is required to level up the strap is to unscrew the bolt. W.

Handy Place for the Die Set

Most pipe or bolt die sets are sold in neat, compact cases to hold each part in its place. In order to get into this case, however, it must be set where it is easy to open the cover.

When a mechanic is doing a bit of work which calls for a die, he goes to the tool room and gets just the die he wants. If the tool room is like most that I have seen,



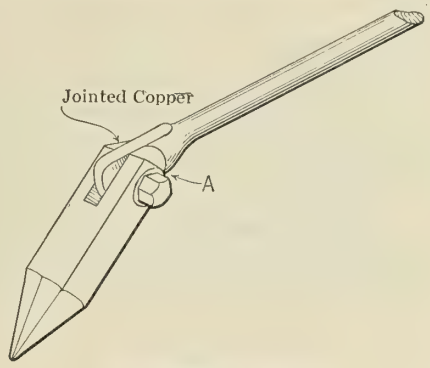
Convenient Arrangement of Die Set Case

the die set case has to be taken down off a shelf and then opened. To save time and make things convenient, I rigged up our die set cases as shown in the sketch, with guide strips on the sides so that the cases can be easily drawn out and the covers opened.

Tool Room Mechanic.

Jointed Soldering Copper

After having done work with a straight regular type of soldering copper that required me nearly to stand on my head to get at it, I hit upon the idea shown in the drawing, that of making a jointed soldering copper that could be used at any convenient angle. To make it was a simple task. The regular straight handle was cut off next to the copper and its end forged out thin and flat. The end of the copper was then slotted to take the flattened end of the handle, a hole having been drilled in it

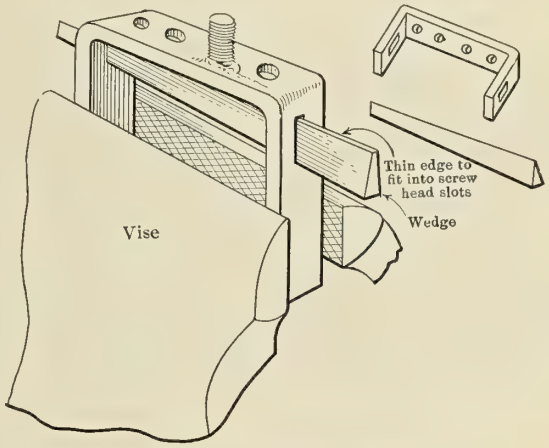


Jointed Soldering Copper

to take the clamping bolt *A*. This tool is worth many times the old straight type. W.

Screw Vise

Sometimes it is necessary to recut down the threads of screws or to hold them without injury while filing the end. The work is easily done by such a vise as shown in



Vise Clamp for Holding Screws

the sketch. This is made from a piece of thin flat bar stock, and a taper wedge with a thin edge that fits into the slot in the screw head, preventing it from turning. The sketch shows the tool in a way that precludes further description.

Concord, N. H. Chas. H. Willey.

How the Germans Destroyed Their Own Ships

In the Panama Canal shipyards at the present time are several large German freight and passenger steamers undergoing repairs. These ships were brought from South American ports, where they had taken refuge from the British navy and had subsequently been interned.

While in port in South America the Germans had done destructive work to the machinery similar to that done by them on many of their boats in American ports at the beginning of the war, engine cylinders being cracked and broken, essential parts of machinery being thrown overboard, etc. American ingenuity has, however, found satisfactory ways to repair the injuries. Engine cylinders, for example, thought by the Germans to have been hopelessly broken, are being oxy-acetylene welded, rebored, and fitted with an inner steel lining. Many upper casings

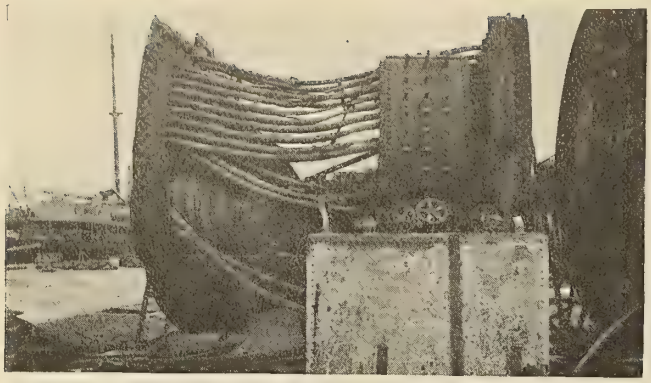


Fig. 1.—Condition of Boiler After Shell Was Removed



Fig. 4.—Combustion Chambers, Tube Sheets and Tubes Beyond Repair

of pumps and other essential parts had been taken off and thrown overboard, but in a number of cases it was possible to locate a similar pump with the casing or part intact. The perfect part could then be used as a pattern and new castings made to replace the missing or broken ones.

In their work of destruction, however, the Germans overlooked a number of things. Commutators of dynamos were damaged badly by being battered with sledges, but



Fig. 2.—Tubes Completely Destroyed

on the same ships were found duplicate spare commutators, carefully boxed up with German thoroughness and in perfect condition to install in place of those wantonly broken. It is a rather curious coincidence, illustrative of the irony of war, that there is being used to a considerable extent in the repairs of these German boats two immense floating cranes, designed and made in Germany. German machinery in American hands repairing German destruction!

Anticipating having to deal with boats badly wrecked inside in an unserviceable condition, the Americans who went down to take them over took with them materials likely to be needed for temporary repairs. Among these were portable power pumps for keeping the bilges clear until the boats should be brought into port, and gasoline (petrol) electric light sets, similar to those used in country houses, to provide temporary lighting of the boats.

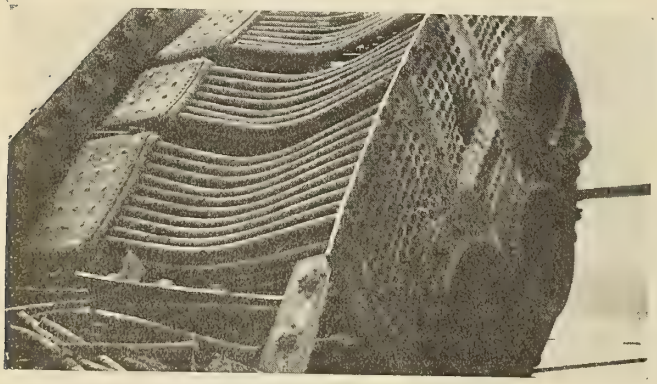


Fig. 3.—The Result of Dry Firing

No steamer can run without its boilers; and while the boilers of all the ships were injured, the Germans made a particularly thorough job of destruction with some of them. The illustrations show some of the boilers damaged to a point of uselessness by "dry firing," the illustrations being taken after the boiler shell had been cut away. This destruction is accomplished by building an extremely hot fire in the boiler while it is unfilled by water. The inside is thereby distorted, the tubes sag and the boiler is in general seriously strained and injured, though usually not beyond the point where it can be made more or less serviceable by skilled workmen.

In the boilers shown, the Germans did the job with the thoroughness for which they are noted, and actually melted parts of the boilers. How they managed to accomplish it with the facilities at hand is a question. These boilers were, of course, beyond repair, and are being cut up by the aid of the oxy-acetylene torch for use as scrap steel.

It might seem to the layman that a far simpler method of destruction would have been simply to open the sea cocks and sink the ships at once. However, international maritime law has something to say on this subject. In war time a ship can be sunk in an enemy's harbor to obstruct traffic and it is considered legitimate warfare. But if a ship is deliberately sunk in a neutral harbor the circumstances are entirely different, for such a sinking constitutes an act of piracy and renders the crew of the vessel liable to the treatment accorded to pirates. The Germans, with due regard to their personal safety, therefore went as far as they dared, but no farther.

VAN ALLEN LYMAN.

A new edition of the Hand Book of Ship Calculations, Construction and Operation, by Charles H. Hughes, naval architect and consulting engineer (price $5), has just been published by D. Appleton & Company, New York. This edition is a revision of the book originally published in 1917 and contains many new tables, as well as changes that have been made necessary by advances in methods of ship construction and in marine engineering practice.

A fifth edition of Stromeyer's Marine Boiler Management and Construction (price $5) has just been published by Longmans, Green & Company, London and New York. No additions have been made to the last edition of the book.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Tank Top Ceiling

Q. (1016).—Describe a good method of laying ceiling on double bottom tanks, and also on tank side brackets.

A. (1016).—On top of the tank, which should have several coats of red lead, apply a thick coat of hot tar, and upon the top of this sprinkle cement.

A common method of laying ceiling is to use athwartship battens of, say, 2 inches by 8 inches, spaced about every two feet. Upon this the ceiling can be laid fore and aft of 2-inch yellow pine or 3-inch spruce. Where vessel is going to be unloaded by grab buckets, a double layer of ceiling is sometimes used, made up of athwartship spruce battens, a layer of 3-inch spruce fore and aft, and an athwartship layer of hard wood birch or maple, if obtainable. Many modern vessels have the inner bottom plating heavier in lieu of ceiling. I have heard of vessels having ceiling laid over tank top manholes without any corresponding hatch in the ceiling. Foremen having this work in charge should realize the trouble they may cause in neglecting this matter.

The ceiling along the tank side brackets is fastened to wood cleats bolted to the brackets. Yellow pine plank 3 inches by 10 inches may be laid fore and aft. Two of these planks should be removable for the length of hold, so that the filth which gathers here may be more readily taken away to prevent the pump suctions from becoming plugged.

Stresses in Shackles

Q. (1017).—Referring to the question on shackle design answered in the June, 1918, issue (question 964-2) I would like to ask the following questions:

Is it correct to consider the semi-circular part of the shackle bow as a portion of the ring when calculating the stresses therein? By the formula used in this connection by Goodenough and Moore, the stress in a 6-inch diameter bar is 12,000 pounds per square inch. In Machinery's Handbook the fiber stress in a 6-inch bar by the formula $S=1.621P\frac{D}{d^3}$ is 27,700 pounds per square inch. Solving for the necessary diameter of bar to give 12,000 pounds per square inch:

$$d=\sqrt[3]{\frac{PD}{0.617S}}=8.2 \text{ inches diameter.}$$

According to Athole J. Murray in his book "Strength of Ships" a fiber stress of 35,300 pounds per square inch would result from using a 6-inch bar. To reduce the stress by his method to 12,000 pounds per square inch, a bar 9½ inches in diameter would have to be used.

If the eye of the shackle is 2¼ inches thick and the shank where the eye is formed 1⅝ inches, Murray's method would indicate a stress of 53,000 pounds per square inch, at the former section and 41,700 at the latter.

Which of the above methods is most nearly correct? Is Murray's method based on the link theory mentioned in the answer of June 1918?

H. F. P.

A. (1017).—We may use one of many formulae for the strength of rings as a basis for calculating the bow:

A.—Goodenough and Moore. $P = 0.4\ C/S$, in which S is purely empirical, based on the results for chain tests. Because of the greater inside diameter, this would tend to everestimate the strength of a shackle bow.

B.—*Machinery.* $P = 0.617\ s\ \frac{d^3}{D}$. This is entirely theoretical, based on the assumption that the maximum bending moment in the ring is $\frac{PD}{2\pi}$ and the stress is found by the straight beam formula $s = \frac{My}{I}$.

C.—Simpson. Similar to *Machinery,* except that the maximum bending moment is that for a beam fixed at the ends with a concentrated load in the center $= \frac{PD}{8}$.

D.—Murray. Entirely theoretical. Bending moment by $\frac{PD}{2\pi}$. Stress found by curved beam formula. Theoretically the most correct method to use.

E.—Robson's Formula. Yield load $P = 42{,}000\ \frac{d^3}{D}$. This is rational, based on tests, and corresponds to a bending moment of about $\frac{PD}{13.5}$ and $s = \frac{My}{I}$.

F.—Method in Halsey's Handbook. Based on Bach's formula for curved beams and then corrected by an empirical constant found by test. This constant is 2 and doubles the load to cause a given stress.

The final answer to any strength calculation is: *E* or *F* of the above formulae are most nearly correct. By *E* for the shackle in question, the diameter would be 6½ inches for a stress of ¼ the yield stress 12,000 pounds per square inch, and by *F* 6 inches for 12,000 pounds per square inch.

Your attention is called to Murray, page 325, in regard to allowable stresses, if figured by his accurate method, ¾ of yield point, or 24,000 pounds per square inch, which you will note corresponds very nearly to Halsey's method of doubling the allowable stress.

In the case considered, I would recommend a diameter of 7 inches to allow for the difference between the shackle bow and a true ring.

You will find that almost any standard shackle will show high stresses at the eye when calculated according to Murray, yet there is no failure of the shackles under working load. If the apparent stress does exceed the yield point, the eye will stretch until it fits the pin exactly; then there can be no further bending stress. Tests of eyes with drilled holes nearly always show failure by direct tension.

Japanese Shipping Losses—.During the war 26 Japanese steamships, totaling 110.451 gross tons, were actually sunk, while 5 vessels of 17,964 gross tons are also regarded as having been sunk by German craft.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

HANNEVIG TO BUILD SHIP REPAIR PLANT

Emergency Fleet Corporation Ends Pusey & Jones Embarrassment

Announcement has been made by Christoffer Hannevig, president of the Pusey & Jones Company, operating shipyards at Wilmington and Gloucester, of the building of an extensive repair plant at the latter yard involving the expenditure of at least $3,000,000 capital, which will be furnished by private Philadelphia interests. Three drydocks will be constructed, of 10,000, 6,000 and 3,000 tons lifting capacity. The company already holds 9,000 feet of water frontage, a suitable site for the new construction.

Public hearings have been held in Philadelphia to discuss the advisability of granting permission to the Pusey & Jones Company to extend 300-foot piers into the Delaware in connection with the project. Some opposition has arisen although a representative of the company explained that any other method of constructing the drydocks would involve additional expense.

Mr. Hannevig also recently announced that the Emergency Fleet Corporation has agreed upon a settlement involving several million dollars for work done by the company at its Wilmington and Gloucester yards, and has also advanced $2,500,000 to the company. All creditors' claims can therefore be settled as presented, and the possibility of receivership is eliminated.

Ten Scout Cruisers Contracted for by the Navy Department

Announcement has been made by Josephus Daniels, Secretary of the Navy, regarding the contractors for the ten scout cruisers which are provided for in the present building programme. Cruisers Nos. 4, 5 and 6 will be constructed by the Todd Dry Dock & Construction Corporation. The Bethlehem Shipbuilding Corporation has been awarded the contract for cruisers Nos. 7 and 8. The other five cruisers, 9, 10, 11, 12 and 13, are to be built by the William Cramp & Sons Ship & Engine Building Company.

Contract Let for Four Steel Tankers

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has received a contract from the Standard Transportation Company for four tank vessels. Two of these vessels, of 12,600 tons deadweight, will be built at the Fore River plant, Quincy, Mass.; the other two, of 10,100 tons deadweight, will be built at the Sparrow's Point plant, Sparrow's Point, Md.

Skinner & Eddy Corporation Orders Steel for Four 10,000-Ton Vessels

The Skinner & Eddy Corporation, Seattle, Wash., has placed an order for steel tonnage with Eastern mills, to be used in building four 10,000-ton cargo steamships for the corporation's own account.

CONTRACT FOR LARGEST BATTLESHIP AWARDED

Navy Department Buying Steel

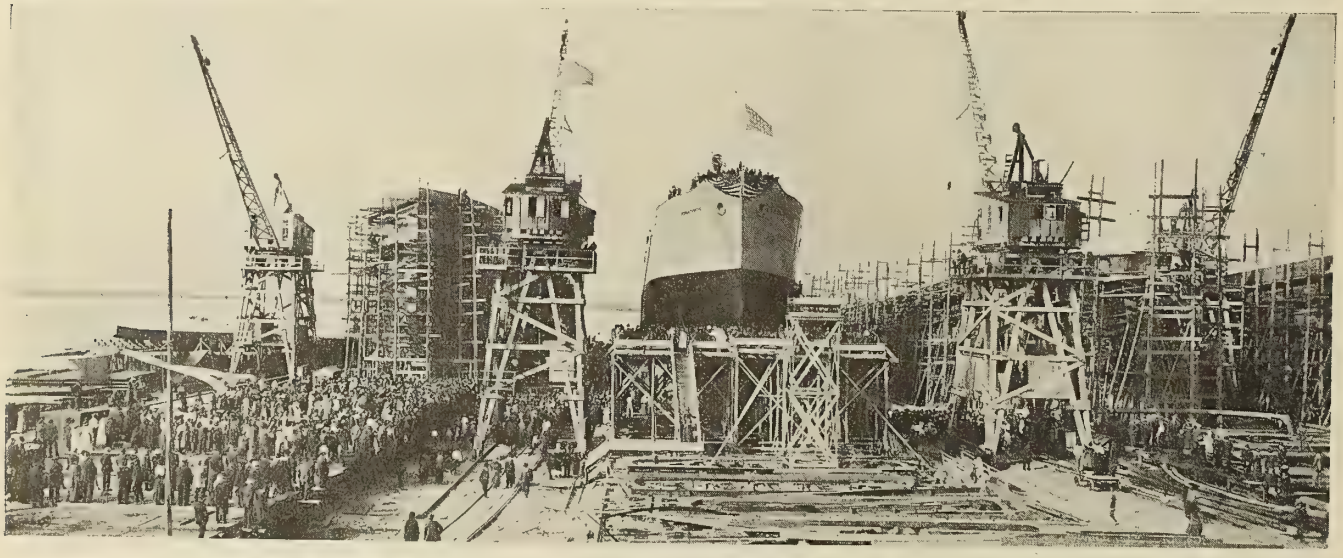
On July 11, Secretary Daniels awarded the contract for the building of battleship *No.* 53 to the Newport News Shipbuilding & Dry Dock Company, Newport News, Va. The cost of the vessel will be about $21,000,000.

The battleship will displace 43,200 tons, will be 684 feet in length, 104 feet beam on waterline, electrically driven by turbine and electric reduction gears, will develop 60,000 horsepower and burn oil for fuel. The ship will have a main battery of twelve 16-inch guns, a secondary battery of sixteen 6-inch guns, and will be equipped with two 21-inch submerged torpedo tubes.

The Navy Department has finally accepted the prices bid on 20,000 tons of plates, shapes and bars ordered for four battle cruisers and one fuel ship. The prices approved apply to 14,000 tons requisitioned from the Carnegie Steel Company, and for 6,000 additional tons for which bids were received.

Baltimore to Purchase Steel Vessels

A group of Baltimore bankers are cooperating with an unnamed New York steamship company for the purchase of a large number of the best type steel vessels, which they plan to operate out of Baltimore. As yet no formal statement has been issued by the Shipping Board, regarding the proposed deal.



Launching Scene at the Yards of the Oscar Daniels Company, Tampa, Fla. The Fourth 9,600-ton Ship *Seminole* Was Launched at These Yards on July 19

CRAMP SHIPBUILDING COMPANY FIGURES IN NEW SHIPPING MERGER

Philadelphia Company to Be Center of Export and Building Corporation

According to a statement issued at Philadelphia, the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., and the Kerr Navigation Corporation, 17 Battery Place, New York, will be absorbed in the newly organized American Ship and Commerce Corporation, the holding company. The new company has been incorporated under the laws of Delaware with a capitalization (all of one class) of 1,500,000 shares of no par value. Not less than 300,000 shares are to be immediately syndicated and offered for sale at $40 per share.

Chandler & Company, Inc., 1328 Chestnut street, Philadelphia, the banking interests bringing about the merger, has announced that the new company will acquire a majority of the stock of the shipbuilding company, and a controlling interest in 50,000 tons deadweight capacity ocean steamships of the new Kerr Navigation Corporation.

"The present operating managements of the Cramp and Kerr companies will remain undisturbed. . . The American Ship and Commerce Corporation will also acquire directly or through subsidiary or associated companies an import and export business." After acquisition of the above interests the new company will have a substantial cash balance to develop international trade.

$200,000,000 Port Terminal Planned

Plans for the construction of a great terminal project off Bayonne, N. J., in New York harbor, affording facilities comparable only with Hamburg and Bremen, have been recently made public. The development calls for an expenditure of about $200,000,000.

The plan, which has been completed by James Stewart & Company, engineers, 30 Church street, New York, and E. P. Goodrich, consulting engineer, and approved, according to the announcement made, by George W. Goethals, President Besler, of the Central Railroad of New Jersey, and President Loomis, of the Lehigh Valley Railroad, is now up for approval before Major-General William C. Black, chief of the engineering staff of the army.

The "Jersey Flats" have been chosen as the site, embracing 1,100 acres of land under shallow water lying off Bayonne, and extending from Bedloe's Island to the Pennsylvania Railroad's Greenville terminal, including the solid rock reef known as Oyster Island.

Army Transport Delivered

The transport *Santa Elisa*, built for the Army by the New York Shipbuilding Corporation, Camden, N. J., was given her trial trip on June 12. Almost from the outset the 3,850-horsepower engines were working perfectly, and but little time was required to bring the number of revolutions up to 79 to 80 per minute. The average speed maintained rown river and bucking a slight tide was 13.58 knots.

SHIPPING BOARD PLANS TO SELL SURPLUS AND SALVAGE PROPERTY

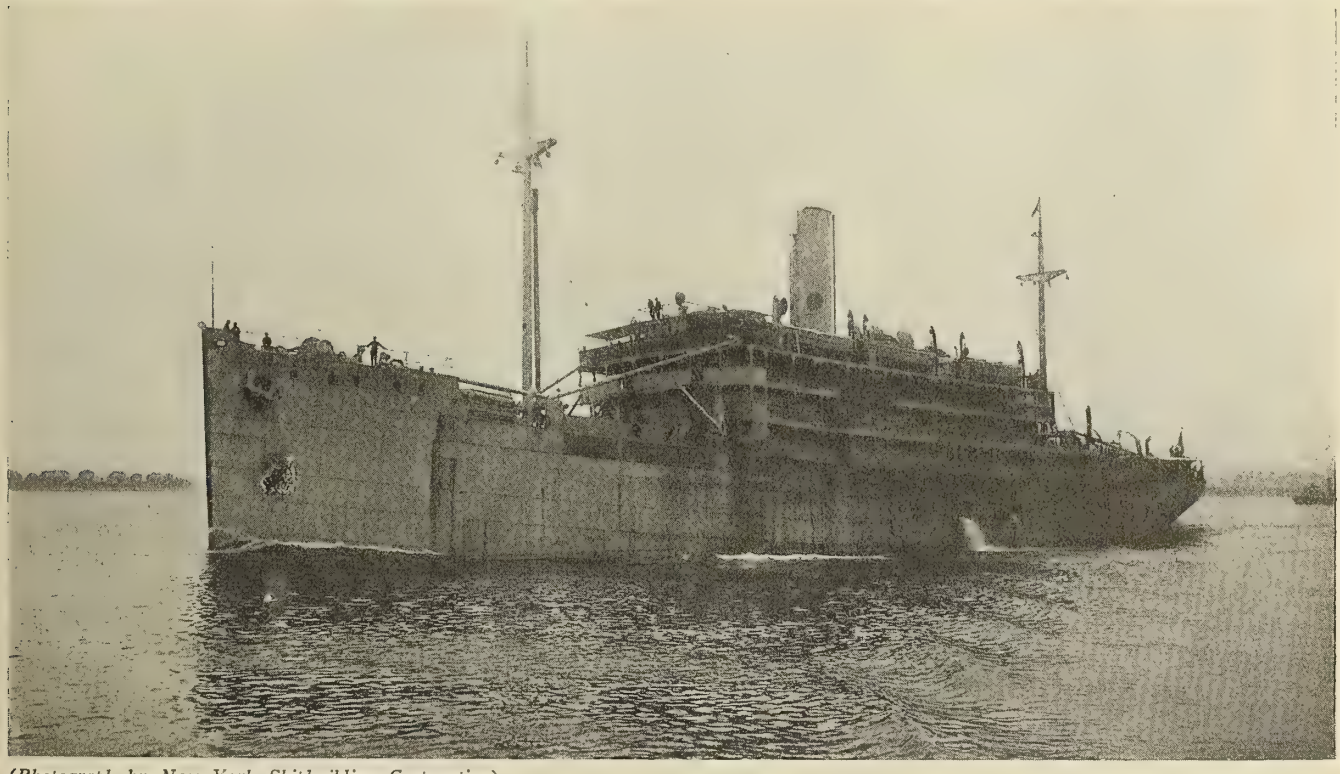
Ships, Shipyards, Drydocks, and Equipment Offered

The United States Shipping Board Emergency Fleet Corporation has arranged for the sale of its surplus and salvage property, including supplies, material and equipment, at such times and in such manner as may be deemed to be to the best interests of the corporation and the nation. Complete manufacturing plants, entire shipyards, drydocks, ships, complete or partially built, and miscellaneous materials including scrap metal will be disposed of by public sale.

The list includes marine railways housing and transportation projects, allotments of machinery, equipment and supplies, including wood-working machinery, machine tools and fixtures, electrical machinery, boiler and forge shop equipment, marine equipment and accessories, air compressor equipment, contractors' equipment and supplies, bridge and gantry cranes, steel plates, shapes and bars, pumping machinery, scrap metals, lumber, deck equipment, galley equipment, and hospital and commissary supplies.

Selling Policy

No open sale, where the original cost of the items covered by one transaction exceeds $5,000, will be final until approved by the Sales Review Board of the Corporation; where a sale is made at prices not lower than the minimum prices established by the Sales Review



(Photograph by New York Shipbuilding Corporation)

The Transport *Santa Elisa*, Which Left for Brest Immediately After Delivery to Bring Back American Soldiers. The Imperfection at the Bow is Not the Result of German Warfare, Only the Result of a Defective Film

Board, such approval will not be necessary.

District managers of the Supply and Sales Division have been appointed to devote their attention to the problems arising out of the warehousing and sales programme in their districts. General information on any phase of the sales activities can be obtained from these representatives or from the home office of the Supply and Sales Division, Philadelphia.

Selling Agencies

Completed ships.—United States Shipping Board, Washington, D. C.

Partially completed ships.—Secretary's Office, Emergency Fleet Corporation, Philadelphia, Pa.

Completed shipyards.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

Completed drydocks and marine railways.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

Completed manufacturing plants.—Shipyards Plant Division, Emergency Fleet Corporation, Philadelphia.

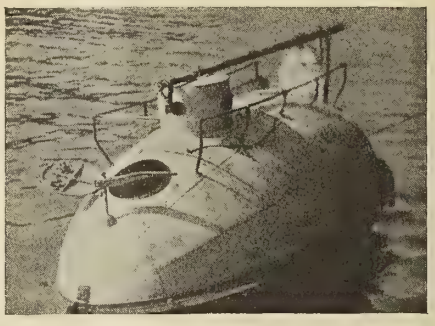
Housing and transportation projects.—Transportation and Housing Division, Emergency Fleet Corporation, Philadelphia.

All property, materials and supplies not assigned to the foregoing will be disposed of by the Supply and Sales Division through its offices in Philadelphia or through the District Supply and Sales Offices in New York, Philadelphia, New Orleans, Chicago and Portland.

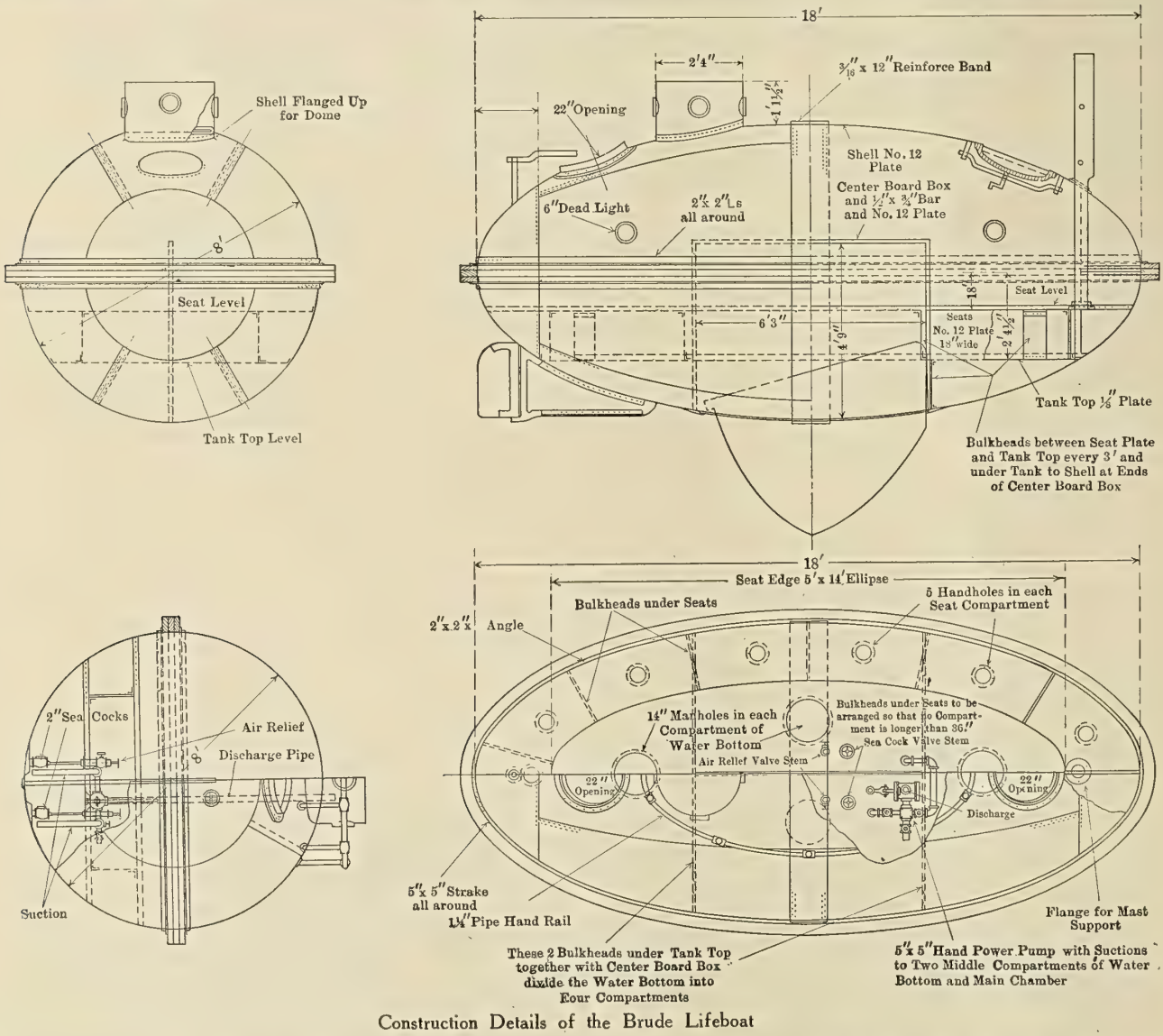
Brude Combined Lifeboat and Life Raft

The question of adequate life-saving facilities and equipment for ships constantly recurs, yet in spite of the lessons learned at great cost during the past four years from naval disasters, little effort has been made to increase the safety of sea travel.

Among other devices designed to accomplish this result, the Brude combined life boat and raft has been thoroughly tested in various shipwrecks and in all kinds of weather to determine its value. In general, the boat has the form of an ellipsoid, built up of steel plates and ballasted with water in four compartments, so that it cannot be capsized. It has a buoyancy of 18 tons and a capacity inside the hull for forty-four persons, while thirty more can find space within the railing on deck. Two manholes give access to the interior, and a small conning tower allows for observation when the hatches are down. Seats for forty people are fitted, and the lockers have capacity for a month's food supply for this number. Motive power is supplied by a small sail or by oars, and a centerboard may be fitted if necessary for beating into the wind.



Brude Lifeboat, Showing Open Hatch and Guard Rail



Construction Details of the Brude Lifeboat

This lifeboat is claimed to be non-swampable and non-sinkable, unless rammed by a ship or smashed against a rocky coast, nor can it be drawn down by the suction of a sinking ship, so that



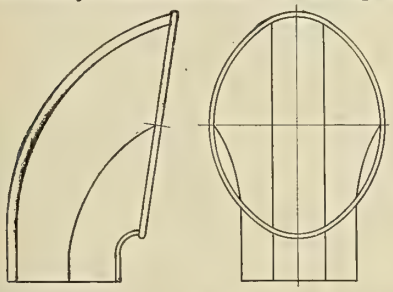
Brude Lifeboat Fitted With Sail

if time is not allowed for proper launching the Brude lifeboat may be left on deck until the vessel sinks under her. It has been dropped nearly 40 feet without apparent injury either to the hull or passengers inside.

The invention was developed in Norway, and for nearly two years has been compulsory equipment on certain ships sailing under the Norwegian flag. In this country the control is held by the Brude Life Boat Company of New York City, Konrad Furubotn, president.

Standardized Ship Cowls

To secure quantity production, the Ohio Blower Company, Cleveland, Ohio, has standardized the ship cowl design previously manufactured. Cowls up to



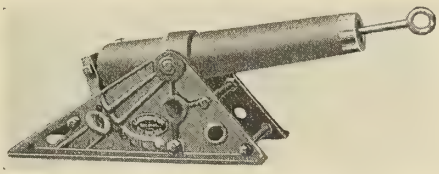
Standardized Ship Cowl. All Cowls Up to and Including 20 Inches Are Made in Four Pieces, 24 Inches and Larger Are Made as Shown

and including 20 inches are made in four pieces; cowls of 24 inches and over are construct as shown in the accompanying sketch. The arched design with few segments furnishes a cowl of rigid structure; and since the shape of the opening is varied but slightly in any section, from the inlet to the neck, and the curves are regular, the skin friction is almost negligible. In finishing the mouth of the "Swartwout" cowl, a piece of heavy pipe is slotted and welded to form an endless ring, which is forced over the mouth of the cowl and securely welded.

By riveting the cowl tube to the neck of the cowl so as to take a length equal to one and one-half times the diameter of the coaming tube, the cowl tube is limited to a short length, making hand operation easy, as the wind resistance is practically eliminated.

Galbraith Line Throwing Gun

A special line throwing gun is being placed upon the market by C. C. Galbraith & Sons, Inc., manufacturers of life-saving appliances, 90 West street, New York. This gun is of forged steel, mounted on a steel carriage. The projectiles weigh 18 pounds, and are turned to within a sixty-fourth-inch of the bore. The length of the latter is 27 inches with a diameter of 2½ inches. The lines are made in accordance with the



Galbraith Line Throwing Gun

rules and regulations of the United Steamboat Inspection Service to withstand a breaking strength of over 500 pounds. The full equipment includes 3 gun lines, 3 projectiles, 6 primers, 3 power charges, 1 lanyard, 1 ramrod and one-half dozen wads. The apparatus is known as the Galbraith line throwing gun.

Largest Oil Tanker Launched

The oil tank steamship *Fernando,* of 18,000 tons deadweight carrying capacity, said to be the largest oil tank steamer in the world, was launched recently by Messrs. Sir W. G. Armstrong, Whitworth & Company, Ltd., Newcastle-on-Tyne, England. This vessel is built to the order of the Eagle Oil Transport Company of London,

Metallo Gasket Company Locates at New Brunswick, N. J.

The Metallo Gasket Company has recently been incorporated for the manufacture of a line of gaskets and other packings at New Brunswick, N. J. The officers of the company are: Zeno Schultes, president and treasurer; Geo. Geipel, vice-president, and Stanley S. Geipel, secretary.

Zeno Schultes was manager of the Goetze Gasket & Packing Company for about fourteen years; George Geipel has been an erecting engineer for some thirty-five years, specializing in refrigerating and steam power plants, and Stanley S. Geipel has had ten years' experience in mechanical engineering. The company will concentrate for a time on its Metallo corrugated copper gasket with asbestos cord inlaid in the copper grooves or corrugations.

Locomotive Crane for Handling Coal and Bulk Materials

Efficient equipment for storing either hard or soft coal, as well as handling sand, ashes, broken stone, iron and other ores, is furnished by the revolving locomotive crane of the type illustrated. This apparatus is placed on the market by the McMyler-Interstate Company, Cleveland, Ohio. The locomotive crane, which is operated by steam or electricity, is equipped with a clam-shell bucket. It can be furnished with a 60-foot boom for operating at a radius at 45 feet, and is provided with couplers and air brakes. In operation the crane can store coal 30 feet high by means of a one-ton clam-shell bucket and can load a 50-ton truck in a few moments. Fifty-five to 70 tons can be handled per hour.



Locomotive Crane for Handling Coal and Bulk Materials

Lehigh Appoints Chapman for New Marine Engineering Course

President H. S. Drinker of Lehigh University has announced the appointment of Lawrence B. Chapman as associate professor in the new course of ship construction and marine transportation which was instituted a year ago in the department of civil engineering.

Professor Chapman, a graduate in naval architecture and marine engineering at the Massachusetts Institute of Technology, taught for a time at the Institute, and was later assistant professor of mechanical engineering in the University of Maine. Since 1915 he has been on the technical staff of the Electric Boat Company, New London, Conn., engaged on technical problems of submarine design and construction.

The Lehigh course in ship construction and marine transportation prepares men to take part in the design and construction of ships and to enter the larger field of marine trade.

Civil Service Openings in the Marine Construction Field

The United States Civil Service announces the following competitive examinations: Schedule No. 343, inspector (male); examination scheduled for August 19; a vacancy is noted in the Public Works Department, Mare Island, Cal. Schedule No. 314, ship draftsman (male or female). Schedule No. 315, general engineering draftsman, architectural draftsman, power plant draftsman, heat and ventilating draftsman and electrical draftsman (male or female). Schedule No. 316, marine engine and boiler draftsman for internal combustion and aero engines, marine electrical draftsman and radio draftsman, (male and female). Schedule No. 317, ordnance draftsman (male and female). Schedule No. 318, aeronautical draftsman (male and female). Schedule No. 250, copyist draftsman (male and female). Schedule No. 356, supervising draftsman (male); examination scheduled August 19; a vacancy is noted in the Bureau of Steam Engineering, Washington, D. C.

Ferguson Steel & Iron Company Building Navy Tug Boats

The Ferguson Steel and Iron Company, Buffalo, N. Y., launched the third seagoing tug *Keewaydin* on its navy contract for six tugs, Wednesday, June 25. Of the two which have previously been launched one has been completely fitted out and accepted by the Navy Department, sailing from Buffalo on June 14.

These tugs are all steel, of 1,000 tons displacement. The machinery consists of two Scotch marine boilers and an 1,800-horsepower triple expansion reciprocating engine. The company is also constructing a wood tug for the State of Pennsylvania and has a contract to build a steel oil barge of about 1,000 tons displacement for private owners.

Gyroscope Exhibit

The Sperry Gyroscope Company, Brooklyn, N. Y., recently furnished an interesting exhibit at the Brooklyn Engineers' Club. Among the apparatus displayed was a 36-inch searchlight mounted in the center of the booth. The latter was lighted to its full candle power and automatically revolved, throwing a circular light around the roof of the armory in which the exhibit was held. A 15-inch marine type pilot house searchlight was also shown. A twin gyro-compass equipment was shown and kept in actual operating condition. The position of the panel and generator, pelorus and repeaters gave an idea of the flexibility of this system and also demonstrated how it is particularly adapted to merchant vessels. Demonstration of the gyroscope was obtained by the use of three small electrically-driven hand models. The production of this company has been practically controlled by the United States and Allied Governments during the war so that intimate knowledge of the company's products has not been available to the public before.

Duntley-Dayton Makes Foreign Connections

The Duntley-Dayton line of pneumatic and electric tools will be marketed in Europe and Australia by the Worthington Pump & Machinery Corporation through an arrangement which has just been made between Mr. W. O. Duntley, president of the Duntley-Dayton Company, and Mr. C. E. Wilson, manager of the foreign department of the Worthington people. The Worthington Pump & Machinery Corporation has branches in practically every European center, with a complete chain of agencies subsidiary to these branches.

BUSINESS NOTES

The Newhall Chain Forge & Iron Company, 90 West street, New York, has recently completed and placed in operation a section of its new shop at Garwood, N. J., for the production of high-grade dredge, crane, steam shovel and foundry sling chains. The accessibility of the Garwood factory, where hand welded heavy chains are produced for the metropolitan and coastwise trade, enables this company to be of special service.

The McMyler-Interstate Company, Cleveland, Ohio, announces the opening of a branch office in the Merchants Exchange building, San Francisco, Cal., in charge of L. A. Somers.

T. J. L. Crane, of the Wales Advertising Company, 110 West Fortieth street, New York, will sail for England on July 1. He will remain abroad for some time, in the interest of clients of the Wales Company.

The Washburne Engineering Company, 30 Church street, New York City, is operating as an engineering and contracting firm for drilling wells and installing suburban water supply systems. The company is particularly well equipped to build contracts on Long Island.

C. C. Cheyney, who served as a naval officer in charge of the mechanical repair shops of the Naval Aviation Station, Pensacola, Fla., during the war, has returned to the Buffalo Forge Company to take charge of the Chicago office and store.

J. W. McCabe, Buffalo manager of sales for the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill., has been appointed special representative for the company's foreign trade department to handle the business in the Orient, Philippine Islands and Australia. W. H. White will cover the Buffalo territory during Mr. McCabe's absence.

Preston Belvin has been appointed Pittsburgh district sales engineer of the International Oxygen Company, Newark, N. J. The company's offices are at 1310 First National Bank building, Pittsburgh, Pa. The Chicago office of the International Oxygen Company has been located at 30 North La Salle street, in charge of Philip G. Wesley.

Capt. H. H. Downes, Twelfth United States Engineers (railway), has returned from France, where he has been stationed since July, 1917. After receiving his discharge he will take charge of the Buffalo Forge Company's interests in the St. Louis territory.

J. J. Brown, formerly vice-president and general manager of the Wheeler Condenser & Engineering Company, Carteret, N. J., was elected president of the company on July 8. H. S. Brown, 50 Congress street, Boston, Mass., was elected vice-president.

R. E. Lovekin, formerly managing director of the American Screw Propeller Company and authority on engineering advertising, has disposed of his interests in the American Screw Propeller Company, and has opened offices at 610-11-12 Penfield Building, Philadelphia, Pa., under the name of R. E. Lovekin, advertising engineer. Mr. Lovekin's experience in engineering and advertising and his acquaintance among shipyard officials and marine engineers fit him especially for work in this field.

R. Lester Thayer has been appointed Philadelphia District Manager of the Wayne Oil Tank and Pump Company, with offices in the Otis building.

C. D. Clary, who has been connected with the Western Electric Company since 1910, at the Philadelphia and Pittsburgh offices, has been made sales manager of the Pittsburgh office.

On June 25-28 a sales convention of the Buffalo Forge Company, Buffalo, N. Y., was held at the country place of the president, H. W. Wendt, Sr. Discussions were carried on regarding the construction of apparatus, built in Buffalo, and other business connected with the affairs of the company.

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

PROSPECTIVE SHIP CONSTRUCTION

100 to 300-ton Vessels for Tropics.—F. C. Luthi & Company, Inc., 277 Broadway, New York, wishes to connect with a shipbuilder able to design and construct small steamers or motor boats for cargo and deck passenger tropical coastwise trade. Vessels of 100 to 300 gross tons only are required; cheapness of construction and operation are important considerations.

8,000-Ton Steel Vessels.—J. Fred Larson, vice-president of the Pacific International Trading Company, and director of the Columbia Pacific Company, accompanied by eleven representatives of Scandinavian countries, it is reported, is scheduled to come to Portland, Ore., to carry out negotiations for tonnage to be placed for these interests. Mr. Larson has the authority to contract for the construction of eight steel ships to be used in trade between the Pacific Coast and Northern Europe.

20,000-Ton Ocean Steamships.—The Nippon Yusen Kaisha, 120 Broadway, New York, according to unofficial reports, plans to build three 20,000-ton steamships for the proposed Seattle-Orient passenger service. The first of these will probably be built in England, to be used as a model for the other vessels to be laid down in Japan. It is also understood that the company proposes to build two or three 6,000-ton ships for service between Shanghai and European ports.

Fireboat, Norfolk, Va.—The city of Norfolk, Va., is planning to purchase a fireboat. Funds are now being collected from railway interests and waterfront property holders. About $250,000 will be expended for the vessel. Details may be obtained from City Manager Ashburne.

SHIP CONTRACTS

Armstrong, Whitworth & Company, Newcastle, N. S. W., has received orders from the Cunard Company for two large steamers of the intermediate class, and an order from the Peninsular & Oriental Company for a large passenger steamer.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has received a contract from the Standard Transportation Company for four tank vessels. Two of these vessels, of 12,600 tons deadweight, will be built at the Fore River plant, Quincy, Mass.; the other two, of 10,100 tons deadweight, will be built at the Sparrow's Point plant, Sparrow's Point, Md.

The Bethlehem Shipbuilding Corporation, Fore River, Mass., has received a contract to build two cruisers, Nos. 7 and 8, for the Navy Department.

The Clinton Shipbuilding Company, Philadelphia, Pa., will build a steel harbor oil barge of 12,000 gallons capacity for the Union Petroleum Company.

The Coastwise Shipbuilding Company, Baltimore, Md., is building the following vessels at its yards: three 2,500-ton coal carrying barges for the United States Shipping Board, a 75-foot motor fishing vessel for a Camden owner, a 175-foot tug for the Northern Transportation Company and four 2,000-tons schooners for the Chesapeake Transportation Company.

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has received a contract to build five cruisers, Nos. 9, 10, 11, 12 and 13, for the Navy Department.

The Defoe Boat and Motor Works, Bay City, Mich., is constructing six 100-foot steel tug boats.

The East Coast Fisheries Company, 7 Wall street, New York, has placed orders for the building of five all-steel steam trawlers. Two of these ships will be built by the J. W. Sullivan Company, Elizabethport, N. J.; two by Kyle & Purdy, City Island, N. Y.; and one by the Ohio Shipbuilding Company, Cleveland, Ohio.

The Hanlon Dry Dock & Shipbuilding Company, East Oakland, Cal., according to a San Francisco report, has received an order to convert three 6,000-ton vessels now building at the yard into motorships, equipping them with twin engines of 1,000 horsepower. These engines are of the Werkspoor design of Dutch origin. The patents were obtained from Holland by the Skandia Engine Company, Oakland, Cal.

The Fred T. Ley Company, Inc., Mobile, Ala., has been given the contract to outfit all concrete vessels built at the Mobile yards, according to an announcement by Robert W. Boyd, assistant in the concrete section, United States Shipping Board, Emergency Fleet Corporation.

The McDonald Engineering Company, Chicago, Ill., is constructing ten concrete ships for the French & Canadian Transportation Company at Port Aransas, Tex. Each vessel, which will cost approximately $200,000, will be 300 feet long, 53 feet wide and 21 feet deep. Each vessel will have a deadweight capacity of 2,200 tons and carrying capacity of 14,000 or 15,000 barrels.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., on July 11, was awarded the contract for the building of battleship No. 53 by Secretary Daniels. The cost of the vessel will be about $21,000,000.

The New York Shipbuilding Corporation, Camden, N. J., has laid keels for three 535-foot vessels at the Gloucester yards for the Emergency Fleet Corporation.

The Todd Dry Dock & Construction Corporation, Tacoma, Wash., has received a contract to build three cruisers, Nos. 4, 5, and 6 for the Navy Department.

The Transatlantic Shipping Company, Gothenburg, Sweden, has now an order with the Gotaverken Shipbuilding Company, Gothenburg, Sweden, for constructing ten motorships. Two of these ships have already been delivered. Of the remaining eight, one will be an oil tanker, 400 feet long, 55-foot beam, with a loaded draft of 24 feet. The dimensions of the other vessels are as follows: Length overall 440 feet, 56-foot beam, and with a loaded draft of 26 feet.

The Union Shipbuilding Company, Fairfield, Md., has a contract to build two 328-foot vessels for the Aluminum Company of America. These ships have a 46-foot beam, and are 24 feet 3 inches deep, with a deadweight carrying capacity of 4,677 tons each.

The Union Steamship Company of New Zealand, Australia, it is reported, has placed an order with a Clyde shipbuilding concern for the construction of a 14,000-ton passenger vessel to operate between Vancouver, B. C., and Australia.

Messrs. Vickers, Ltd., England, have received a contract from the Donaldson Line, Ltd., Glasgow, Scotland, for the construction of an 8,000-ton deadweight ocean-going steamer.

Messrs. J. Samuel White & Company, Ltd., England, has secured a contract to build twelve 200-ton steel barges for Messrs. Cory & Son.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Crane Runways, Brooklyn, N. Y.—McClintic Marshall Company, 715 Munsey building, Washington, D. C.,

has entered the lowest bid for furnishing crane runways for shipbuilding slip No. 1 and for bulkhead handling, etc., at the New York Navy Yard, Brooklyn, N. Y.

Drydock, Brooklyn, N. Y.—Harry Cossey, Staten Island, is constructing an 8,800-ton floating drydock for the Clinton Dry Docks Company, a subsidiary of the Todd Shipyards Corporation, Clinton street, Brooklyn. When completed the dock will have an overall length of 428 feet, be 114 feet wide, and capable of handling vessels up to 500 feet long. The company is also building one 800-foot and one 600-foot pier at this site.

Drydock, Hoboken, N. J.—The W. & A. Fletcher Company, Hoboken, N. J., has announced the placing of contracts for an 8,500-ton floating drydock to be constructed at the New Jersey plant. The pontoons will be built by John Monks & Sons, 82 Beaver street, New York city.

Drydock, Jacksonville, Fla.—H. R. Dillingham, Heard building, Jacksonville, Fla., district plant engineer of the United States Shipping Board, may be addressed concerning the purchase of a floating drydock being constructed at Jacksonville, Fla., which will be sold to the highest bidder upon completion. At least $500,000 will be expended for construction and equipment before the dock is ready for operation.

Drydock, Mill Basin, Brooklyn, N. Y.—The Atlantic Gulf & Pacific Company, 13 Park Row, New York, has received a contract from the Emergency Fleet Corporation to build a 14-pontoon drydock at Mill Basin, Brooklyn. Construction will be of wood throughout, each pontoon being 80 by 116 feet. Wing walls are 45 feet high. The dock will be arranged in sections to accommodate vessels of 10,000 to 12,000 tons, each section accommodating approximately 2,000 tons. The pontoons will be operated by electrically-driven pumps. All material is being supplied by the Emergency Fleet Corporation, which will operate the drydock on completion.

Drydock, Pensacola, Fla.—The Aberthaw Construction Company, Boston, Mass., has received a contract for the construction and equipment of a 5,000-ton drydock of the Crandall type, to be built at Pensacola, Fla. This dock, which will cost about $450,000, will consist of five floating pontoons, each 100 by 20 feet, 10 feet deep. Each of the pontoons will be equipped with four electric centrifugal pumps, designed to empty the dock in one hour.

Drydock, Savannah, Ga.—Four pontoons of the new 8,000-ton sectional floating drydock, designed by the Crandall Engineering Company, Boston, Mass., which is being built for the Savannah Dry Dock & Repair Company, Port Wentworth, Savannah, Ga., are about complete.

Drydock and Buildings, Sorel, Quebec, Canada.—The Sorel Shipbuilding Company, Sorel, Quebec, Canada, plans to construct a drydock and necessary buildings. About $150,000 will be expended on the construction. J. N. Leclair, Sorel, Quebec, is the engineer.

Drydock and Harbor Improvements, Courtnay Bay, St. John, N. B.—The St. John Dry Dock & Shipbuilding Company, Ltd., St. John, N. B., has received a contract from the Dominion Government for the construction of harbor improvements at Courtnay Bay, which will cost about $5,000,000. These developments include the construction of a breakwater, entrance channel, basin and quay wall. In conjunction with this work the company is building for its own use a drydock 1,150 feet in length with a width of 125 feet and a depth of 40 feet at high water. H. R. Dufresne is manager.

Drydock and Machine Shop, Mariners' Harbor, Staten Island.—The Brewer Dry Dock Company, Mariners' Harbor, Staten Island, has practically completed a new steel and brick machine shop, 50 by 80 feet. An inside gallery was built by John Milnes Company, Port Richmond, S. I. When finished the structure will be equipped to handle all kinds of marine repairs. The company also plans to build a drydock 400 feet long by 100 feet wide. The structure will take a vessel of 6,000 tons.

Drydock Pontoon and Dredge Hull, Portland, Ore.—The Port of Portland Commission, Portland, Ore., closed bids on July 10 for the construction of the sixth pontoon for the St. Johns drydock. Bids were accepted only from plants in the Port of Portland district. Bids from the same locality were opened on July 24 for the construction of a hull for the dredge **Columbia** operating in this region.

Drydocks.—The Narragansett Shipbuilding Company, Tiverton, R. I., the Kingston Shipbuilding Company, Kingston, N. Y., and the Arverne shipyard, managed by W. H. Gahagan, Arverne, L. I., are building large drydocks for the Emergency Fleet Corporation. Official word has not been received, but it is supposed that these drydocks will be operated by the Ramberg Iron Works, Inc., Brooklyn, N. Y.; the Perth Amboy Dry Dock Company, Perth Amboy, N. J., and Fraser, Brace & Company, New York.

Marine Electrical Equipment Factory, Seattle, Wash.—The Horne Manufacturing Company, Brooklyn, N. Y., is establishing a factory for the manufacture of marine electrical equipment in Seattle, Wash. The company's present offices are located at 222 Grand Trunk Pacific building, Seattle, Wash.

Pattern Shop, Philadelphia, Pa.—N. H. McClosky, 1620 Thompson street, Philadelphia, Pa., has entered the lowest bid for the construction of a pattern shop at the Navy Yard, Philadelphia, Pa.

Propeller Wheel Factory, Albany, N. Y.—The Thacher Propeller & Foundry Company, Albany, N. Y., recently incorporated, with an actual capital of $1,000,000, will take over the business conducted by George H. Thacher & Company, North Albany. The essential purpose of this new incorporation is to push the marine business, particularly the patent process of propeller wheel manufacture. The company has let a contract for a new building to be constructed at the plant to cost between $150,000 and $200,000.

Ship Repair Plant, Gloucester, N. J.—Announcement has been made by Christoffer Hannevig, president of the Pusey & Jones Company, operating shipyards at Wilmington and Gloucester, of the building of an extensive repair plant at the latter yard involving the expenditure of at least $3,000,000 capital, which will be furnished by private Philadelphia interests. Three drydocks will be constructed of 10,000, 6,000 and 3,000 tons lifting capacity. The company already holds 9,000 feet of water frontage, a suitable site for the new construction. Public hearings are now being held in Philadelphia to permit the company to build 300-foot piers. The proposition has met with opposition.

Ship Repair Plant, Staten Island, N. Y.—Fraser, Brace & Company, 1328 Broadway, New York city, has begun the construction of a ship repair plant which it will operate at Staten Island, N. Y. The plant will include a sectional drydock of 10,000-ton capacity, piers and all the necessary equipment for adequate ship repair work. The drydock will be operated by electrically-driven centrifugal pumps.

Ship Repair Plant, Wilmington, Del.—The Keystone Ship Repair Company has been incorporated by T. L. Corteau, P. B. Drew and C. L. Rimlinger, Wilmington, Del., with a capital of $100,000.

Shipbuilding Ways, Brooklyn, N. Y.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract for reconstructing shipbuilding ways in Brooklyn, N. Y., to the Phoenix Construction Company, 41 Park Row, New York City, for $697,897.

Shipfitters' Shop, Boston, Mass.—Levering & Garrigues, 552 West Twenty-third street, New York city, has entered the lowest bid for the construction of the addition to the shipfitters' shop to be built at the Navy Yard, Boston, Mass.

Shipyard, Camden, N. J.—The Penn Shipyards Corporation, Camden, N. J., has been incorporated by Robert D. Hughes, Camden, N. J., Samuel Edelman, Philadelphia, Pa., and David McKnight, Jr., Palmyra, Pa., with a capitalization of $1,000,000, to build vessels, engines and ship equipment.

Shipyard, Morehead City, N. C.—Edward S. Meadow & Company, Newbern, N. C., has taken over the Shipping Board's shipyard at Morehead City, N. C.

Shipyard, Newport News, Va.—The Southern Shipyard Corporation, Newport News, Va., which has been organized with a capital of $200,000, is planning to build a new yard at Newport News, Va. The plan will include a Crandall Marine railway of 3,000 tons capacity and several smaller ways. Sanford & Brooks Company, Baltimore, Md., has been awarded the contract for constructing a 3,000-foot bulkhead and a pier 500 feet by 40 feet, and the Truscon Steel Company, Youngstown, O., has received a contract to build six steel structures with concrete floors.

Shipyard, Portland, Me.—The Job Shipyard Corporation has been incorporated to build vessels. R. L. Johnson, president, Portland, Me.; H. I. Smith, treasurer, Portland, Me.; A. B. Farnhamn, clerk, Portland, Me.

Shipyard, Racine, Wis.—The Badger Boat Company, Racine, Wis., has been incorporated, with a capital of $10,000, by Martin Draeger, William Draeger and Clarence Bornofski.

Shipyard, Shanghai, China—A Chinese concern, known as the Sung Fuh Yue Company, has recently purchased seventeen acres near the arsenal at Shanghai, China, on which it is planned to erect a modern shipyard.

Shipyard Extension, New York—The Underpinning & Foundation Company, 290 Broadway, New York City, has entered the lowest bid for the rebuilding of a shipbuilding way at New York, as called for in the specifications issued by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Wood Shipyard, Mount Pleasant, S. C.—The E. O. Hall Boat Yard Company, Mount Pleasant, S. C., has been incorporated by Walter B. Wilbur and others, with a capital of $10,000, to construct wooden ships.

PROPOSED CONSTRUCTION

Breakwater, Racine, Wis.—P. H. Connolly, Racine, Wis., is receiving bids for the building of a breakwater at Racine to extend about 2,500 feet.

Canal, New Orleans, La.—The United States Engineer Office, Custom House, New Orleans, La., is planning to construct a six-mile canal from Bayou Teche to Vermillion River, to cost about $350,000.

Coal Dock, Duluth, Minn.—The Northwestern Fuel Company plans to build a 1,000,000-ton coal dock. This will be 1,500 feet long and 500 feet wide, and will cost about $1,000,000. The dock will be equipped with a 500-foot span Brownhoist bridge and a 10-ton clam-shell bucket.

Coaling Wharf, New Orleans, La.—The United States Naval Station situated at New Orleans, La., plans to increase the present coaling wharf. About $90,000 will be spent for the work.

Concrete Unloading Dock, St. Joseph, Mo.—The St. Joseph Warehouse & Cold Storage Company, St. Joseph, Mo., will extend a concrete unloading dock. Structure to cost about $20,000.

Dock, Parkersburg, W. Va.—The Ohio River Dock Company, Parkersburg, W. Va., is planning the construction of a dock at that city. The company, which is capitalized at $50,000, has been formed by H. A. Winters and C. D. Dodson.

Docks, Baton Rouge, La.—The Aluminum Ore Company, St. Louis, Mo., it is reported, is planning to build extensive docks at Baton Rouge, La., which will be used as a shipping port for South American trade. The company denies that any definite proposition is now being considered.

Dredging, Gray's Harbor, Wash.—The Port Commission, Gray's Harbor, Wash., will spend $10,000 for improvements, and such further sum as may be necessary in order to deepen the channel of the inner harbor, the main shoal of which is opposite Gray's Harbor city.

Dredging and Rock Removal, East River, N. Y.—The United States Engineer Office, Room 710, Army building, 39 Whitehall street, New York, will receive sealed proposals for dredging and rock removal in the East River, N. Y., until 12 noon, August 7, 1919. Further information on application.

Drydock, Brooklyn, N. Y.—The Navy Department, Washington, D. C., is arranging for an appropriation of about $6,000,000 for the reconstruction and improvement of drydock No. 3, at the New York Navy Yard, Brooklyn, N. Y. This will include ship construction and repair facilities.

Drydock, Oswego, N. Y.—The A. R. Hinckley Company, Oswego, N. Y., is planning the erection of a new ship repair plant estimated to cost about $100,000. The new plant will include machine tools and machinery for ship repairs and construction, drydock, marine railway, cranes, hoisting machinery, etc. Construction is postponed, however, temporarily, pending the action of the State in granting property for the company's use.

Fill, Astoria, Ore.—Bids have been opened at Astoria, Ore., for the filling in of reclamation district No. 3, which will be used for the development of several large harbor projects.

Freight Shed, Rothesay, N. B.—C. R. Brown, Moncton, N. B., is receiving bids for the construction of a freight shed at Rothesay, N. B., to cost about $100,000.

Harbor Improvements, Berkeley, Cal.—R. P. Jennings, Berkeley, Cal., has leased the Berkeley waterfront with the exception of 100 feet, for fifty years, and plans to spend $2,000,000 within five years and $1,000,000 additional within ten years of signing of lease to build piers or moles and warehouses.

Harbor Improvements, Charlotte, Fla.—Government engineers have recommended to Congress that the authorized improvements at Charlotte harbor, Fla., be enlarged so as to provide a channel 47 feet deep and 300 feet wide from the Gulf of Mexico to the town of Bocagrande. The increased cost is estimated at $100,000.

Harbor Improvements, Newport Beach, Cal.—The Board of Supervisors, Orange County, Santa Ana, Cal., has appropriated the following amounts to improve the harbor of Newport Beach, Cal: $137,000 for cutting new channel for the Santa Ana River through sand; $270,000 for dredging channel in bay; $43,000 for wharf, warehouse and railroad connection; $50,000 for extending rock jetty. Leeds & Barnard, Central building, Los Angeles, Cal., are the engineers in charge of the work.

Harbor Improvements, Tacoma, Wash.—One million five hundred thousand dollars' worth of bonds have already been sold for the $2,500,000 harbor improvements planned by Tacoma, Wash. An initial expenditure of $350,000 will be used for fills, riprapping and piling.

Lining Concrete Drydock, Paris Island, S. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to line a drydock at Paris Island, S. C., with concrete. About $25,000 will be spent on the project.

Loading Dock, St. Helens, Ore.—The St. Helens Dock & Terminal Company, St. Helens, Ore., plans to construct a 2,500-foot loading dock. Further details regarding the work may be obtained from H. F. McCormick, St. Helens Lumber Company, St. Helens, Ore.

Machine, Electrical, Pattern, Steel and Lumber Storage Shops, Norfolk, Va.—The House Naval Appropriation Bill carries $400,000 for machine and electrical shops, $400,000 for a pattern shop, and $300,000 for a steel and lumber storage shop, all of which are to be constructed at the Norfolk Navy Yard, Norfolk, Va.

Pier, Burlington Channel, Can.—The Department of Public Works, Ottawa, Ont., plans to construct a 200-foot pier at Burlington channel to cost about $24,000.

Pier and Yacht Basin, Gulfport, Miss.—The Pinellas Company, Gulfport, Miss., is planning to build a 500-foot pier and yacht basin. This will also be used as a commercial dock.

Pier and Warehouse, San Diego, Cal.—F. A. Rhodes, city engineer, San Diego, Cal., may be addressed concerning construction details of a new pier and warehouse which the city plans to build.

Power Plant, Boston Navy Yard—

The House Naval Appropriation Bill carries $100,000 for a power plant to be constructed at the Boston Navy Yard.

Rolling Mill, Sydney, Nova Scotia.—The Federal Government of Canada, according to an announcement by C. C. Ballantyne, has issued to the Dominion Steel Company a contract for 250,000 tons of ship plates. This order will involve the construction of a large rolling plant at Sydney, Nova Scotia, to cost about $5,000,000.

Sea Wall, Rockwood, Mich.—W. H. Adams, Vinton building, Detroit, Mich., may be addressed concerning the construction of a sea wall at Rockwood, Mich., to cost about $20,000.

Ship Channel, Beaumont, Tex.—The Beaumont Navigation District, Beaumont, Tex., has advertised the sale of $300,000 in bonds for the purpose of improving the ship channel.

Shipping Docks, Texas City, Tex.—The Humble Oil & Refining Company, W. S. Farish, vice-president, Houston, Tex., will construct new shipping docks in Texas City, the capacity of which will be 20,000 barrels.

Shipyard Improvements, Power Plant, Pattern Shop, etc., Philadelphia, Pa.—The House Naval Appropriation Bill carries $1,000,000 for general developments, $500,000 for a power plant, and $400,000 for a pattern shop, to be constructed at the Philadelphia Navy Yard, Philadelphia, Pa.

Steel Storage Plant, Brooklyn, N. Y.—The House Naval Appropriation Bill carries $200,000 for a steel storage plant to be constructed at the New York Navy Yard, Brooklyn, N. Y.

Steel Warehouse, New Orleans, La.—James W. Porch, of the Lukens Steel Company, 626 South Peters street, New Orleans, La., has announced that the Lukens Steel Company, one of the eleven companies forming the Consolidated Steel Corporation, will build a $300,000 steel warehouse at that port to retain steel for export purposes.

Terminal, Bayonne, N. J.—Plans for the construction of a terminal project off Bayonne, N. J., in New York harbor, affording facilities comparable with Hamburg and Bremen, have been recently made public. The development calls for an expenditure of about $200,000,000. James Stewart & Company, 30 Church street, New York, is the consulting engineer. The proposition has the approval of George W. Goethals, President Besler, of the Central Railroad of New Jersey, and President Loomis of the Lehigh Valley Railroad.

Terminal, Dorchester Bay, Mass.—George P. Hamlin, Boston, Mass., has recently outlined a plan for a large terminal development upon Dorcester Bay, which would co-ordinate all the railroads of Boston into an inner and outer belt line. This scheme would provide a more efficient approach to the army base at South Boston, and the auxiliary navy yard at Squantum. Dorchester has practically a straight roadway to the sea, and is within communication distance of the above development and of the New Haven Railroad wharves and yard.

Warehouse, Seattle, Wash.—The Seattle Warehouse Company, 107 Jackson street, Seattle, Wash., has received a building permit to construct two $200,000 warehouses in the new industrial district. The site of the warehouses, which is on the county dock property, will make it possible to connect the structures with the Duwamish waterway, also with the railroad spur on East Marginal way.

Wharf, Coos Bay, Ore.—The port of Coos Bay, Ore., is negotiating for one of two harbor sites upon which it is proposed to build a large public wharf with adequate rail connection. Large warehouses will be constructed The work is in charge of James Polhemus. Coos Bay has already expended $600,000 in deepening the harbor.

Wharf, Darien, Ga.—The city of Darien, Ga., has voted $10,000 for the construction of a municipal wharf.

Wharf and Elevator, Monroe, La.—Walter G. Kirkpatrick, consulting engineer, Monroe, La., may be addressed concerning a municipal wharf and elevator to be constructed at that place.

Wharves, Equipment and General Improvements, Vancouver, B. C.—The Dominion Government has appropriated $5,000,000 for general improvements to the harbor at Vancouver, B. C., including wharves and equipment. R. G. Swan, Ottawa, Ont., is the engineer.

EQUIPMENT

Boilers and Superheaters, Charleston, S. C.—The Heine Safety Boiler Company, 1120 Pennsylvania building, Philadelphia, Pa., has received a contract to install boilers and superheaters at the Charleston Navy Yard, Charleston, S. C., to cost about $41,750.

Bridge and Wall Cranes, Mare Island, Cal.—Bids have been asked for furnishing and installing one 80-ton, four 15-ton and two 5-ton bridge cranes, together with fourteen 5-ton and six 3-ton wall cranes in the new structural shop at the Mare Island Navy Yard. The estimated cost is $250,000.

Cranes, Brooklyn, N. Y.—Niles-Bement-Pond Company, 111 Broadway, New York City, entered the lowest bid for the furnishing of cranes at the New York Navy Yard, Brooklyn, N. Y., to cost $85,165.

Elevators, New York.—The Albro Clem Elevator Company, D street and Erie avenue, Washington, D. C., has entered the lowest bid for furnishing elevators at New York, as called for in the specifications issued by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Machinery and Boilers, Glasgow, Scotland—Messrs. Cammell Laird & Company, Ltd., Birkenhead, has received from Napier & Miller, Glasgow, an order for two sets of geared turbine machinery of the double reduction type, together with boilers fitted for burning oil fuel for two steamers of 9,500 tons, which they are biulding for the Norwegian-American Line of Christiania.

Shafting and Machinery Installations, Hoboken, N. J.—Frank Tracey, 202 Center street, New York city, has received a contract from W. & A. Fletcher Company, Hoboken, N. J., for shafting and machinery installations on the 8,500-ton floating drydock to be constructed at the New Jersey plant.

Steel Wings, Hoboken, N. J.—The American Bridge Company, Pittsburgh, Pa., has received a contract from W. & A. Fletcher Company, Hoboken, N. J., to furnish the steel wings for the 8,500-ton floating drydock to be constructed at the New Jersey plant.

Trailers and Trucks, New York City.—Bids were closed on July 15, by E. S. Walsh, Superintendent of Public Works, Albany, N. Y., for furnishing, delivering and testing industrial freight handling trailers and stevedore freight handling trucks for the barge canal terminal at New York City. Contract has been awarded to the Lansing Company, 492 Broome street, New York City, for $9,250.

CONSTRUCTION CONTRACTS LET AND PENDING

Boat Shops and Concrete Floor, San Francisco, Cal.—The Board of State Harbor Commissioners, San Francisco, Cal., has recently let two contracts—one for the building of the Fisherman's Boat Shops at Fisherman's Lagoon, and the other for the laying of a concrete floor and foundation to be used in connection with the proposed vegetable oil plant at Islais Creek.

Boathouse, Wharf and Boat Basin, Galveston, Tex.—Bids were closed on July 31, by the Treasury Department, Washington, D. C., for the building of a new boathouse, wharf and boat basin for the United States Quarantine Station, Galveston, Tex. J. A. Wetmore is the supervising architect.

Bulkhead, Passaic River, N. J.—Linde & Griffith, Fourth street, Newark, N. J., has received a contract to build a bulkhead on the Passaic River at the cost of $16,500.

Concrete Retaining Wall, St. Louis, Mo.—The M. Cates Stock Company, Syndicate Trust building, St. Louis,

Mo., has let a contract to J. W. Strupps Company, 240 Second street, Kansas City, Mo., for the construction of a reinforced concrete retaining wall, 4 miles long and 20 feet high, 30 miles northwest of St. Louis.

Dock, Choctaw Point, Fla.—The C. H. Turner Company, Pensacola, Fla., has received a contract to construct a dock at Choctaw Point at the cost of $40,000 for the Texas Oil Company.

Dock, Old Point, Va.—The Boyle-Robertson Company has received a contract from Major Arthur H. Lloyd, construction quartermaster, Old Point Va., for the building of a dock upon the Government premises to cost about $111,000.

Dock, Wyandotte, Mich.—A. J. Dupuis & Company, 1022 Ford building, Detroit, Mich., has received a contract to build a dock at Wyandotte, Mich., to cost about $16,000.

Dredging, Mobile Bay, Ala.—The Atlantic Gulf & Pacific Company, Mobile, Ala., has received a contract to dredge 1,000,000 yards at Arlington Pier, Mobile Bay.

Earth Levee, Newport, Ark.—W. H. Dennison, Cushman, Newport, Ark., has received a contract to build a new earth levee at Newport, Ark., to cost about $165,000.

Dredging, Portland, Ore.—General Black, chief of the United States Engineer Corps, has recommended to the Secretary of War that the city of Portland be permitted to dredge the channel at the head of the Columbia slough. As the result of this action contracts will probably be signed with the Pacific Bridge Company for the carrying out of the work, which will cost about $309,450.

Jetty, Jacksonville, Fla.—Bids were closed on July 24, by the United States Engineer Office, Jacksonville, Fla., for the construction of a jetty at that place.

Lock and Abutment, Ohio River—The Dravo Contracting Company, Diamond Bank building, Pittsburgh, Pa., has been awarded the contract to build a lock and abutment at Dam 32 on the Ohio River.

Pier, Gulfport, Miss.—The city of Gulfport, Miss., began the construction of a pier about July 27. H. D. Shaw, city engineer, is in charge of the work.

Pier, Philadelphia, Pa.—Simpson & Brown, 90 West street, New York, has received a contract to build the Penn Treaty Recreation Pier, No. 57 North Delaware River, Philadelphia, Pa., at the cost of $75,156.

Pier, Toronto, Canada—The Department of Public Works, Ottawa, Canada, will soon let a contract for rebuilding a portion of superstructure of east pier at eastern entrance to Toronto harbor, 400 feet long, 30 feet wide. E. Lafleur, care of Department of Public Works, is the chief engineer.

Pier and Freight Shed, Astoria, Ore.—Bids were closed on July 1, by the Port of Astoria Commission, Astoria, Ore., for the construction of Pier 3 and freight shed No. 4, including all labor and materials except the electrical work, plumbing and sprinkler system and the hydraulic fill, which will be done by the Port of Astoria.

Pier and Fire Protection System, Bellevue, D. C.—The McHarg-Barton Company, 171 Madison avenue, New York City, has received a contract from the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a pier and installing a fire protection system at Bellevue, D. C., to cost $47,000.

Pier Sheds, Victoria, B. C.—Under the supervision of F. W. Cowie, harbor engineer, Montreal, Can., is constructing pier sheds on Number 17 and 18 Victoria pier. The work is being carried out by the Dominion Bridge Company.

Storage Tanks, Portland, Ore.—The Commission of Public Docks, Portland, Ore., closed bids on June 26 for the construction of six steel storage tanks to accommodate 16,000 barrels of vegetable oil at the St. John's import and export municipal terminal.

Terminal and Frame Freight House, Flushing, N. Y.—Bids were closed on July 15 by E. S. Walsh, Superintendent of Public Works, Albany, N. Y., for the construction of a barge canal terminal and frame freight house at Flushing, Borough of Queens, N. Y. Contract has been let to McHarg-Barton Company, New York City, for $151,340.

Warehouses—W. M. Sutherland Building & Contracting Company, Savanna, Ill., has received a contract to build forty warehouses to cost about $1,500,000.

Wharf, Berthier, Ont.—Bids were closed on July 24, by R. C. Desrochers, Department of Public Works. Ottawa, Ont., concerning a wharf which it is planned to build at Berthier, Ont.

Wharf, Comas, B. C.—The Department of Public Works, Ottawa, Ont., closed bids on July 15 for repairing a wharf at Comox, B. C., consisting of pipe and timber superstructure, 1,014 feet long, 20 feet 8 inches wide and 100 by 137 feet at the end, with about 300 piles. The estimated cost of the work is $20,000. E. Lafleur, chief engineer, Department of Public Works, is in charge of the work.

Wharf, Cornwall, Can.—Bids were closed on July 22, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Canada, for building wharf at Cornwall, Ontario.

Wharf, Magog, Quebec, Canada—T. P. Charleson, 149 Gilmour street, Ottawa, Ontario, Can., has received a contract from the Dominion Government, Ottawa, to build a wharf at Magog, Quebec, to cost about $14,924.

Wharf, Vercheres, Quebec—Contract has been let to L. & J. Trudel to rebuild a wharf at Vercheres, Quebec. The contracting company is located at St. Irenee.

Wharf, Williams Head Quarantine Station, B. C.—W. Greenlees, 47 Cordova street, Vancouver, B. C., has received a contract for repairing wharf 41 by 482 feet at Williams Head Quarantine Station, 9 miles southwest of Victoria, B. C., to cost about $19,415.

Wharf, Ste. Anne de Beaupre, Quebec, Canada—Bids were closed on July 23, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Ontario, Canada, for rebuilding and repairing wharf at Ste. Anne de Beaupre, Quebec, Canada.

Wharf, St. John, N. B.—The Engineers & Contractors, Ltd., 102 Prince William street, St. John, N. B., has been awarded the contract to construct a wharf at St. John, N. B., to cost about $28,500.

Wharf and Dredging, Powell River, B. C.—Bids were closed on July 31, by the Department of Public Works, Ottawa, Canada, for the building of an addition to wharf and dredging at Powell River, B. C., to cost about $165,000. E. Lafleur, Department of Public Works, is the engineer.

Hurley Resigns From Shipping Board

On July 10, formal announcement was made of the resignation of Edward N. Hurley as chairman of the United States Shipping Board, to take effect August 1. In view of Chairman Hurley's valuable assistance in carrying out the extensive shipbuilding programme, his resignation was accepted by President Wilson with reluctance.

Mr. Hurley intends to establish offices in the principal cities of the country where advice will be given to small manufacturers as to efficient means of carrying out the solution of particular business problems.

Although the statement is not official, it is supposed that John Barton Payne, of Chicago, will succeed Mr. Hurley as chairman of the Shipping Board.

Mark Hyman Appointed General Counsel of the Shipping Board

Mark Hyman, who as special assistant United States attorney general has prosecuted important cases in connection with Government anti-trust suits against the Eastman Kodak Company, and engaged in inquiries into the clay, fireproofing and conduit associations, the cement association, patent license restricting cases, and the recent Hog Island investigation, has been appointed counsel for the United States Shipping Board.

Charles R. Page, San Francisco, Cal., until recently a member of the United States Shipping Board, has been elected treasurer of the Atlantic, Gulf & West Indies Lines.

Shipbuilding Changes at Greenock

Important changes in the control of several industrial establishments in Greenock and the surrounding district have either been made or are in process of being carried out. The engine works and foundry of Harland & Wolff (late Caird & Company) has been acquired by a Port Glasgow firm, whose name is not given out. Messrs. Harland & Wolff will, however, still be in the engineering business, and it is understood that the company will become identified with the firm of John G. Kincaid & Company, Greenock, which has large works in the east end of the town. The latter firm has no foundry. Within recent years this company has carried out very large extensions, and it is possible that further expansion will be undertaken in the near future.

Harland & Wolff contemplate an extension of their shipbuilding yard. If carried out this change will give employment to many more thousands of workers. It is also reported that two Port Glasgow Shipbuilding yards have changed hands. The business of W. Ferguson Bros. has been bought by Slater, London, who already controls the firm of Murdoch & Murray, Port Glasgow. The business will be carried on under the old name. Both of these Port Glasgow yards have reputations for turning out a splendid type of smaller craft. Ferguson Bros. have done much work for the Admiralty, for whom the company has built a large number of tugs.

The other firm reported to have changed hands is the Clyde Shipbuilding & Engineering Company. A London firm is said to be interested in the purchase. The Clyde business includes a fitting-out basin.

J. Samuel White & Company, Ltd., East Cowes, Isle of White, delivered the 1,000-ton displacement ocean-going torpedo-boat destroyer *Trusty* to the Admiralty rcently. The vessel was constructed, engined and fully equipped by the firm. It is the seventieth of the type produced by the company.

PERSONAL

E. O. Cutler, vice-president of the Groton Iron Works, Groton, Conn., and of the Virginia Shipbuilding Corporation, Alexandria, Va., following his resignation as manager of the former concern, which is now entirely controlled by the newly appointed receivers, is making his headquarters at the companies' New York office, 50 Broad street, in connection with the negotiation of new contracts to follow the completion of vessel contracts now under way with the Emergency Fleet Corporation. Both companies specialize in a standardized 9,400-ton steel steamer of the shelter-deck type. The combined yards have ten well-equipped ways for building steamers up to 15,000 tons deadweight.

John T. Cushing, assistant director of operations, has been stationed in Washington to act as director of operations during the absence of John H. Rosseter from the Capitol. He is assisted by W. F. Taylor.

F. C. Williams, formerly with the Division of Operations of the United States Shipping Board, has been appointed superintending engineer of the Cosmopolitan Shipping Company, 42 Broadway, New York city.

Rear Admiral David W. Taylor, U. S. N., chief of the Bureau of Construction and Repair, and Rear Admiral Robert S. Griffin, U. S. N., chief of the Bureau of Steam Engineering of the United States Navy, have been awarded the cross of the Commander of the Legion of Honor by the French Government.

Mrs. E. J. Schoonmaker has been appointed treasurer of the Bantam Ball Bearing Company, Bantam, Conn., upon the resignation of Miss Ruth Edwards.

At a meeting of the board of managers of the American Bureau of Shipping held on July 1, Commodore Ellsworth P. Bertholf, formerly commandant, and Captain Charles A. McAllister, Engineer-in-Chief of the United States Coast Guard, were duly elected members of the board of managers, and were also elected vice-presidents.

At a meeting of the Board of Directors of the Western Electric Company held on July 1, 1919, Charles G. Du Bois was elected president to succeed H. B. Thayer, who resigned after thirty-eight years of service to become president of the American Telephone and Telegraph Company. After graduating from Dartmouth in 1891, Mr. DuBois entered the accounting department of the Western Electric Company. In 1898 he was made secretary of the company, with offices at Chicago, having supervision over the branch houses. In 1917 he served as comptroller with the American Red Cross, rejoining the Western Electric Company as Vice-President in 1918.

Joseph J. Nelis, for the past year with the engineering section of the Emergency Fleet Corporation, Philadelphia, Pa., has accepted a position with the Power Specialty Company, 111 Broadway, New York, as marine representative for Foster boilers, superheaters and air heaters.

Admiral William B. Caperton, U. S. N., late commander in chief of the Pacific Fleet, was retired from active duty on June 30. Since his graduation from the United States Naval Academy in 1875, Admiral Caperton has served in all waters, including active duty in Cuba during the Spanish-American war, service in Latin-America during uprisings and revolutions, and from April 1917 to March 1919, as commander in chief patrolling the Pacific coast.

Announcement has been made of the appointment of William Baird as general agent, passenger department, of the Canadian Pacific Ocean Services, Limited, with office at the Pier Head, Liverpool, England.

Captain John W. Inglesby, for the past two years head of the sea service and sea training bureaus of the United States Shipping Board for the Hampton Roads district, resigned on July 1.

B. W. Morse has resigned as vice-president and general manager of the United States Steamship Company, New York, to re-enter the ship brokerage business, from which he had retired during the period of the war. Mr. Morse will continue on the board of directors of the United States Steamship Company and all subsidiary companies. He will be succeeded by his brother, E. A. Morse, who is also president of the Groton Iron Works, Groton, Conn., a subsidiary of the United States Steamship Company.

William R. Virtue, president of the Maritime Transportation Company, 11 Broadway, has resigned to become New York manager of Crowell and Thurlow, Boston, Mass., whose offices are located at 44 Whitehall street.

Robert W. Reford, president of the Robert Reford Company, Ltd., has been elected to the board of directors of the Cunard Steamship Company, Ltd., with which the former company is now affiliated.

OBITUARY

Oscar Otto, general superintendent of the South Philadelphia Machine Works, of the Westinghouse Electric and Manufacturing Company, died on June 30, as the result of fatal injuries received in an automobile accident four days previous. Mr. Otto was born in Manitowoc, Wis., where he finished his apprenticeship with the Central and North West Railway before serving with the Northern Pacific Railroad Company at Tacoma. Later he went with the Oregon Short Line, Salt Lake City, and in 1898 became superintendent of the Chicago shops of the Chicago and North Western Railway. In June, 1909, he became general superintendent of the Westinghouse Machine Works, East Pittsburgh, Pa., later supervising the installation of machinery at Essington, Pa., until he was transferred to the South Philadelphia plant.

William E. Simpson, formerly with J. F. Simpson & Company, New York, and of late years in the service of the United States Government Assay Office, New York, died at his desk on July 11. Mr. Simpson, who was familiar with drydock construction, was the son of James E. Simpson, who is said to have invented and built the first timber basin dry dock.

		8 to 12 P. M.
		4 to 8 P. M.
		12 to 4 P. M.

Log sheet inspected prior to copying, and approved.

The *Cushing* was our first torpedo boat and was de- seams in the drums were welded instead of riveted. The

KEEPING THE ENGINE ROOM LOG

Form of Log Sheet Used in the United States Navy

Engine-room Log—Type S. (Class 2.)
(Small vessels—Turbine machinery.)
**Sheet. Bu. N. & E. 160.
(Rev. 8-18.)

ROUGH SHEET FOR USE IN ENGINE ROOM.

U. S. S. ..... *at* ..... *or en route from* ..... *to* ..... *Date* ....., 191

Table No. 1.	*REVOLUTIONS PER MINUTE. †Shafts. No. 1. Reading of Counter.	No. 1. R. P. M.	No. 2. Reading of Counter.	No. 2. R. P. M.	No. 3. Reading of Counter.	No. 3. R. P. M.	* Average R. P. M. All Shafts.	*Speed per hour, knots, from R. P. M. (Col. 1.)	*VACUUM. S.	*VACUUM. Y.	TEMPERATURES. Injection.	Overboard Discharge.	Feed Tank.	Boiler Feed Leaving Heater.	STEAM PRESSURES. GAUGE. Boilers.	GAUGE. Engine Room.	ABSOLUTE. *Back Pressure Auxiliary Exhaust	Table No. 1.
Hours.							1	2	3		4	5	6	7	8	9	10	Hours.
1																		1
2																		2
3																		3
4																		4
5																		5
6																		6
7																		7
8																		8
9																		9
10																		10
11																		11
Noon.																		Noon
	ⓟ		ⓟ		ⓟ		Total,		Clock set ahead	minutes or back	minutes at							M.
1																		1
2																		2
3																		3
4																		4
5																		5
6																		6
7																		7
8																		8
9																		9
10																		0
11																		1
Mid.																		Mid.
	ⓟ		ⓟ		ⓟ		Total,		Clock set ahead	minutes or back	minutes at							M.

Table No. 1.	(a) TURBINE STEAM PRESSURES. GAUGE. (Initial Steam Chest or Steam Belt.)	ABSOLUTE.	FUEL USED. COAL—NUMBER OF BUCKETS. Fireroom. 1	2	3	TOTALS. COAL. Buckets.	*Tons.	Oil (Gallons).	FIREROOM DATA. FUEL OIL. Pressure at Burners.	Temperature. To Heater.	From Heater.	No. of Burners in Use.	* Air Pressure.	DYNAMO DATA. Steam Pressure.	Volts.	Amperes.	Table No. 1.
Hours.	11	(b) 12			13		14		15	16	17	18	19	20	21	22	Hours.
1																	1
2																	2
3																	3
4																	4
5																	5
6																	6
7																	7
8																	8
9																	9
10																	10
11																	11
Noon.																	Noon
							Total,										
1																	1
2																	2
3																	3
4																	4
5																	5
6																	6
7																	7
8																	8
9																	9
10																	0
11																	1
Mid.																	Mid.
							Total,										

Table No. 5.—FRESH WATER RECORD, AT NOON—GALLONS.

Compartment.	On Hand.	Received or Distilled.	Expended.
Feed Tank { S.			
Feed Tank { P.			
Totals.			

Boiler.	†† Quantity.	Gallons.	Grains Chlorine.	Per Cent Alkalinity.
Totals,				

GRAND TOTAL,

Table No. 6.—LUBRICATING OIL.

Oil used, noon to noon	
Oil received	
Oil on hand at noon	

Table No. 7.—FUEL RECORD, ESTIMATE AT NOON {OIL—GALLONS. COAL—TONS.

Compartment.	On Hand.	Received.	Expended.
Totals,			

FORCED LUBRICATION SYSTEM.

Hours.	Pressure.	Temperature of Oil. To Cooler.	From Cooler.	Warmest Bearing.
3 A. M.				
6				
9				
Noon.				
3 P. M.				
6				
9				
Mid.				

†† TURBINE CLEARANCES.

Watch.	△	△	△	△	△
Mid.– 4					
4– 8					
8–12					
12– 4					
4– 8					
8–Mid.					

DRAFT, DISPLACEMENT, ETC.

§ Draft, forward ..... aft ..... mean	
§ Displacement in tons	
§§ Revolutions per minute per knot	
Number of days out of dry dock	
Condition of ship's bottom	
Temperature outside air at noon	
Weather conditions	

Table No. 8.—AUXILIARY MACHINERY IN OPERATION.

NAME OF AUXILIARY.	TIME. Started.	Stopped.	Elapsed.

KEEPING THE ENGINE ROOM LOG

Reverse Side of Naval Log Sheet

REMARKS.

RECORD OF WATCHES OR DAY'S DUTY.

Enter no data below that is recorded elsewhere in tables. Enter all inspections, casualties, and items of importance.

MEMORANDUM SPACE FOR USE OF OFFICER OF WATCH.

12 to 4 A. M.

4 to 8 A. M.

8 to 12 A. M.

12 to 4 P. M.

4 to 8 P. M.

8 to 12 P. M.

Log sheet inspected prior to copying, and approved.

4—4044

....., *Engineer Officer.*

RECORD OF WORK DONE BY SHIP'S FORCE.

ENGINE ROOM.

FIREROOMS.

AUXILIARY STATIONS.

*RECORD OF SIGNALS AND CHANGES IN REVOLUTIONS.

Time.	Change.	Resultant Revs.	Time.	Change.	Resultant Revs.
1	2	3	1	2	3

4—4044

* In the case of change in revolutions make entries as indicated at head of column. For signals "stop," etc., write out in full the signal in second column, with time in first column, and resultant revolutions in third column.

SUPPLEMENTARY LOG INSTRUCTIONS.

SPEED.

As directed in log instructions, speed to be recorded in column 2 is based upon revolutions of the propelling machinery (column 1) regardless of foulness of screws or ship's bottom, displacement, trim, weather conditions, currents, etc. When, however, opportunity offers to secure actual speed through the water, as when steaming in squadron, under fairly constant speed conditions, where distance (200 knots or more) covered, as astronomically determined by a number of ships, is obtainable; or when running for any considerable time between land bearings where chart distance is measured, **actual average speed per hour** and **average revolutions per minute per knot** should be entered on Sheet A. For example, with but slight variation in speed, and steaming between bearings without sensible change in course, a distance of 276.9 knots is covered by a triple-screw turbine vessel in 12 hours and 36 minutes, the total revolutions (all screws) being 975,240. Entry on Sheet A, under "Remarks" should be: **average speed, 18 knots; average revolutions per minute per knot, 23.88.**

STEAM PRESSURES.

Due to the large variety of naval installations, it is not feasible to so designate or head turbine-steam-pressure columns (numbered 12, reverse side of this sheet) as to provide for all types and combinations. Such spaces are left blank, therefore, and should be headed on ship-board to suit the particular type and combination installed.

In entering pressures on this and other log sheets, the following instructions are to be carefully observed: Pressure in pounds is to be recorded in all cases as **gauge** or **absolute**, as set forth below, and **absolute** pressure is to be understood as gauge pressure plus 15 pounds; where compound gauges (pounds-inches) are installed, graduated to read pounds pressure above the atmosphere, and in inches (mercury) for pressures below the atmosphere, the latter is to be converted into pounds pressure by computing each 2 inches equivalent to 1 pound pressure:

(a) For fire room gauges, and such gauges as are connected to main or auxiliary steam lines in engine room, or elsewhere, readings recorded should be **gauge.**

(b) Pressures in steam chest of Curtis or Zoelly turbines should be recorded in **gauge**, and first and succeeding stages in **absolute**; for Parsons turbine propelling machinery, the initial (for steam belt) pressure should be recorded as **gauge**; succeeding pressures in any stage, or turbine, when recorded, should be in **absolute.**

(c) On vessels fitted with turbines, where reciprocating machinery is installed for cruising speeds, the H. P. steam chest pressure is to be recorded as **gauge**, and all receiver pressures as **absolute.**

(d) For steam-operated auxiliary machinery, pressures that are invariably above the atmosphere should be recorded as **gauge**, and those invariably below the atmosphere as **absolute.** When, however, a change in operating conditions of any auxiliary produces a change in the pressure to be recorded, so that at times such pressure is above and at other times below the atmosphere, **absolute** pressure should always be recorded.

MACHINERY INDEX AND MACHINERY HISTORY.

In order to standardize the system of recording work, casualties and their causes, examinations, etc., naval vessels using this type of engine-room log should make up a "machinery index," consisting of a list in proper nomenclature of each and every "machinery unit," under the cognizance of the Engineer Officer, and as outlined below, to include every "machinery unit" for the operating condition of which he is responsible.

The term "machinery unit" is to be understood as:

(a) One boiler, one pump, one evaporator, one generator, one lathe, etc.

(b) Subdivisions of the propelling machinery, and other complicated installations, i. e., high-pressure cruising turbine; port main turbine, starboard astern turbine; port propeller, etc.; forward heating system, starboard main suction piping, port fire and bilge pump, overboard discharge piping, etc.

(c) Individual compartments, such as drum rooms, wash rooms, double bottoms, etc.

Each "machinery unit" is to be given a "machinery index" number; these index numbers once assigned are permanent numbers. All units of the firerooom stations should preferably bear numbers (from 1 to 100; on the engine-room stations, 101 to 200; and for outside auxiliary stations, index numbers from 201 to 300 (or above). For example: Boiler No. 1 is given index No. 1; the forward auxiliary feed pump (installed in fire-room) bears index No. 13; index No. 101 possibly would be high-pressure cruising turbine; index No. 106, port main air pump; index No. 201, ice machine, etc. For complicated machinery units, the index, if desired, may be further subdivided as follows: Index No. 1 being assigned to Boiler No. 1, any particular part of this boiler may be definitely designated by use of a combination of figures and letters, thus: Index No. 1-a might indicate the safety valve of Boiler No. 1; 1-b, the stop valve, etc.

A "machinery history" of each "machinery unit" should be kept, the history to be typewritten quarterly on D sheets of the loose-leaf log, one copy to be forwarded to the Bureau of Steam Engineering with the quarterly engine-room log, the duplicate copy to be permanently bound with the ship's copy which is retained on board.

The "machinery history" of each "machinery unit" should be a chronological record showing every casualty and its cause, repair, modification, alteration, replacement, overhaul, inspection, or examination that the "machinery unit" has undergone (whether by ship's or yard force) during the quarter. Each entry in the "machinery history" should set forth clearly, but briefly, what work was done, or condition found upon inspection, etc.

On the daily data (A) sheet of the log, under "Remarks," it is necessary only to enter the machinery index numbers of the "machinery units" on which work was done, thus:

Firerooms—
Index Nos. 1, 13.
Engine rooms—
Index Nos. 101, 106.
Auxiliary Station—
Index No. 201.

Further entries relative to such work are not required on A sheets.

At the end of each quarter the record of work is transcribed on D sheets (using both sides), as follows: First, a list of index numbers with the names and description of corresponding machinery units, this being necessary to enable the Bureau and all persons who are or who may be connected with the engineering department on board ship to identify the various machinery units. Following the list of machinery index numbers is the machinery history of each unit for the quarter; that, beginning with No. 1 there is written the date corresponding to notation on daily data (A) sheet of the entry, i. e., the casualty, its cause, repair, overhaul, examination, etc. Succeeding entries continue the numerical and chronological record in sequence of every unit on which work was done, or which was inspected during the quarter; thus:

Index No.	**Date.*	*Remarks.*
1	1-25	Removed and replaced 28 grate bars.
	2-16	Examined water side; pitting observed around drum opening of surface blow, extending over an approximate area of 6 by 8 inches, the deepest pit being about $\frac{1}{16}$ inch; either interior parts free from pits.
13	1-26	Overheated and repacked water piston, substituting Tuck's for flax packing originally installed.
	2-14	Removed head for examination of steam cylinder, piston, etc.
101	2-3	Hoisted upper casing for examination of interior parts of turbine. Cupolons of rotor and blading as follows: * * *
106	2-2	Renewed 2 bent guards and 2 receiving valves, etc.
201	2-4	Examined compression cylinder piston, and renewed leather packing.

*NOTE.—Use figures to indicate month and day; thus: 1-2, 2-14, etc. (omit year).

As heretofore pointed out, the "machinery index" when once made up for any vessel, should require no change, from quarter to quarter, except in event of replacement of a "machinery unit." Extreme care, therefore, should be exercised that the "machinery index" completely covers the machinery installation, and that identifying or important descriptive characteristics of each unit (type, make, size, etc.) are briefly noted in the index; for example:

Index No.	*Name and description of unit.*
1	No. 1 boiler; Normand type (oil-burning) fitted with 12 burners; diameter (inside) of (1) upper and (2) lower drums, 44 and 19 inches, respectively; 116 1¼-inch tubes, 1.20 mils in thickness, and 1,264 1¼-inch tubes, 100 mils in thickness; furnace volume, 630 cubic feet; heating surface, 8,277 square feet.
2	No. 2 boiler; same as above.
*	* * * * *
7	Forward auxiliary boiler; single-ended, Scotch type; diameter (outside) 10 feet; length (extreme) 9 feet 6 inches; 312 3¼ inch tubes, 9 feet 10 inches long (166 ordinary of 109 mils thickness, and 60 size of 203 mils thickness); grate surface, 82 square feet; heating surface, 976 square feet.
*	* * * * *
13	Forward (No. 1) auxiliary (oil pump; Warren, vertical, double-acting, single; diameter of steam cylinder, 12 inches, and of water cylinder, 10 inches; stroke, 16 inches.
*	* * * * *
101	H. P. cruising turbine; diameter of rotor, 80 inches; number of expansions, three, 18 rows of blading to each; length of blade, ⅜, ½, and ⅝ inches.
*	* * * * *
106	Port main air pump; Warren, vertical, twin, bucket, single-acting; one steam cylinder, 14 inches diameter; two water cylinders, 26 inches diameter, with stroke (common), of 18 inches.
*	* * * * *
109	Port (left-handed) propeller, Three-bladed, manganese bronze, cast solid; diameter, 7 feet 4 inches; mean pitch, 9 feet 3 inches; helicoidal area, 23.7 square feet.
*	* * * * *
201	Allen, dense-air, vertical, ice machine; rated cooling effect, ½ ton; diameter of cylinders: steam, 8 inches; compressor, 4¾ inches, expander, 4 inches; stroke (common), 9 inches.
*	* * * * *

The system above outlined possesses the advantage of making the engine-room log a history of the engineering department, with little or no more clerical work than involved in daily entries on A sheets; and, furthermore, repairs, casualties, examinations, etc., of every machinery unit during the quarter is thus segregated, eliminating the necessity of searching through each page of the quarter's log to ascertain information pertaining to any particular machinery unit.

A machinery index should be inserted in each quarter's log, and the index and history should immediately follow the daily data (A) sheets for the quarter and be paged accordingly. In order to obviate the necessity of typewriting, the index may be in printed form on D sheets if facilities are available on shipboard.

FIG. 2

ORD OF WORK DONE BY SHIP'S FORCE.

ENGINE ROOM.

FIREROOMS.

AUXILIARY STATIONS.

SUPPLEMENTARY LOG INSTRUCTIONS.

SPEED.

As directed in log instructions, speed to be recorded in column 2 is based upon revolutions of the propelling machinery (column 1) regardless of foulness of screws or ship's bottom, displacement, trim, weather conditions, currents, etc. When, however, opportunity offers to secure actual speed through the water, as when steaming in squadron, under

Firerooms—
Index Nos. 1, 13.
Engine rooms—
Index Nos. 101, 106.
Auxiliary Station—

INTERNATIONAL

Marine Engineering

SEPTEMBER, 1919

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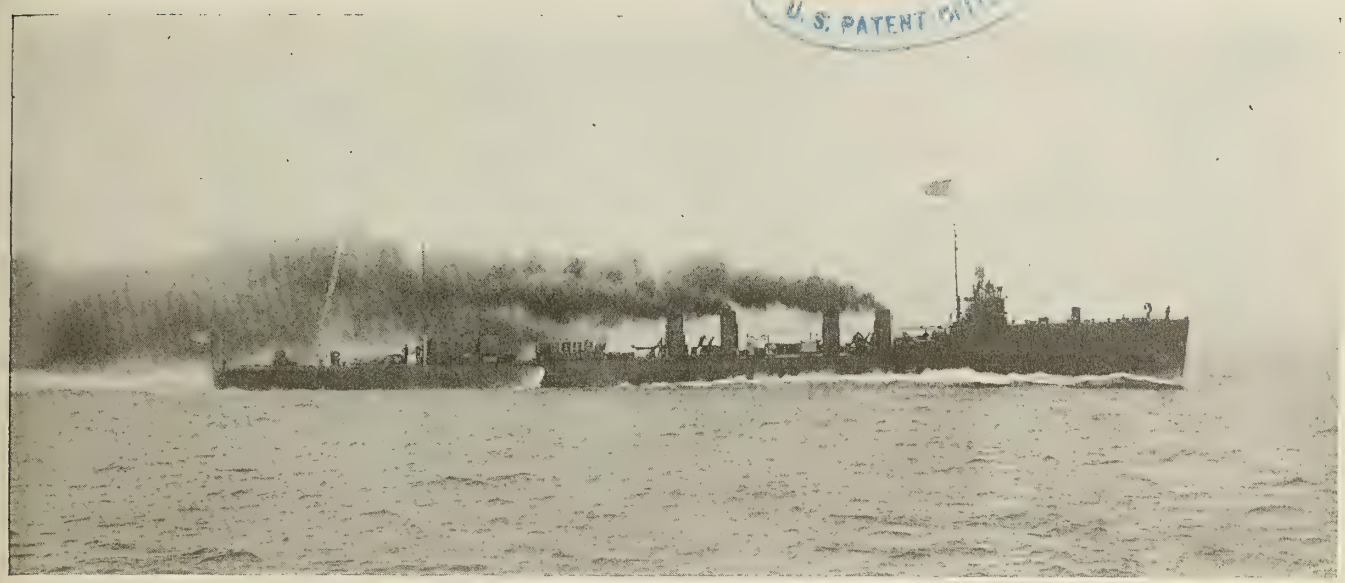


Fig. 1.—*Smith* Class Destroyer. These Vessels, Built in 1909, Were the First American Turbine-Driven Destroyers

The Evolution of the Destroyer

Remarkable Development of Present-Day Destroyer from Early Type Torpedo Boat—Rapid Advances in Boiler and Turbine Construction

BY COMMANDER S. M. ROBINSON, U. S. N.

PROGRESS in marine engineering has been very rapid during the past thirty years, but it is believed that the development of the torpedo boat has been more rapid than that of any other type of vessel. Undoubtedly the main reason for this rapid progress is that it takes a very short time, comparatively, to build a destroyer, so that the engineer can test his ideas and make several advances in the time required to build one battleship. It is certainly a far cry from the 22.5-knot *Cushing* to the 36.88-knot *Dent*. The *Cushing* was our first torpedo boat and the *Dent* is one of our latest destroyers. The following table and accompanying photographs give a comparison between the two boats:

	Cushing	*Dent*
Length overall	137 feet 6 inches	314 feet 4½ inches
Beam, extreme	15 feet ½ inch	30 feet 1½ inches
Draft	4 feet 6 inches	9 feet 0¾ inch
Displacement	91.34 tons	1,159 tons
Fuel	33 tons coal	288 tons oil
Speed	22.5 knots	36.88 knots
Horsepower	1,720 (indicated)	28,190 (shaft)
Revolutions per minute	370	467.5
Number of screws	2	2
Cruising radius at 10 knots' speed	990 knots	at 15 knots, 4,960 knots
Boilers	2 Thornycroft	4 White-Forster
Total heating surface	4,750 square feet	27,000 square feet
Total grate surface	76.6	
Ratio of heating surface to grate surface	62 to 1	

The *Cushing* was our first torpedo boat and was designed and built in 1890 by Nathaniel Herreshoff at the Herreshoff Works, Bristol, R. I. Inasmuch as she represents our maiden effort in this line of marine engineering, a brief description of her machinery may be of interest.

Machinery of the Cushing

She was equipped with twin screws, each driven by a five-cylinder, quadruple expansion engine. The cylinders were 11½, 16, 22½, 22½ and 22½ inches in diameter, respectively. The stroke was 15 inches. The engine supports were a distinct advance in engineering for that day and consisted of 1½-inch steel rods, braced diagonally, and forming the cap bolts of the main bearings; the latter were secured to a bed-plate consisting of a single sheet of ¾-inch wrought iron with openings cut for the cranks. The bed-plate was secured in a fore-and-aft direction to keelsons and was also supported under the main bearings of the high-pressure and after low-pressure cylinders, the other main bearings being entirely without support; but, owing to the extreme care taken in balancing, the engines ran without vibration.

The boat was equipped with two Thornycroft boilers each having 38.3 square feet of grate surface and 2,375 square feet of heating surface. The boilers also represented an advance in engineering, as the longitudinal seams in the drums were welded instead of riveted. The

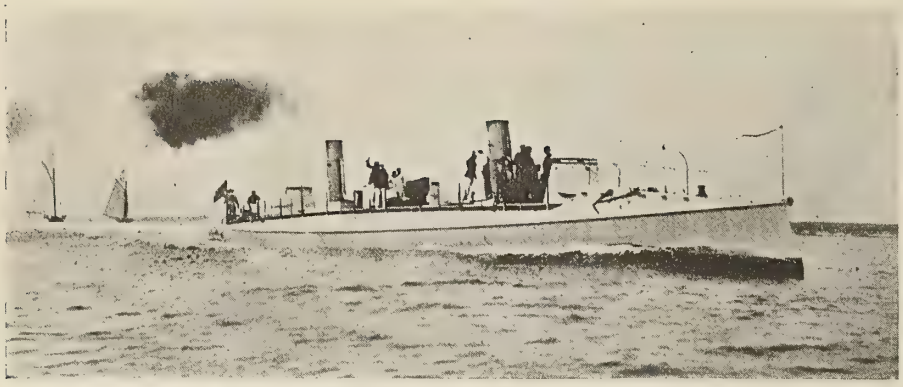


Fig. 2.—The *Cushing*, the First United States Torpedo Boat

boilers were designed for a pressure of 250 pounds per square inch.

For some time after the trials of the *Cushing*, the advance in torpedo boat engineering was limited by the progress in the design of propellers and the art of balancing engines. Like many other points of engineering, the screw propeller was not as well understood at that time as it is to-day, and many failures on trials were recorded due solely to improper propeller design. Also the higher speed of ship desired required higher engine speeds than had been the custom, with the result that vibration was so bad in many cases as to make it impossible to run at full power. However, both of these problems were successfully solved and the art of engine balancing, in particular, was carried to a high degree of success. This line of development reached its climax with the *Stewart* class, which were built in 1902.

The Last of the Reciprocating Engine Boats

The following table gives the general characteristics of these boats:

Length	245 feet
Beam	23 feet ¼ inch
Draft	6 feet 1¼ inches
Displacement	444 tons
Speed	29.3 knots
Indicated horsepower	8,000
Revolutions per minute	330
Number of screws	2
Fuel, coal	180 tons
Boilers	4 Thornycroft
Total heating surface	17,770 square feet
Total grate surface	237 square feet
Ratio of heating surface to grate surface	56.4 to 1
Radius of action at 12 knots	2,160 knots

These were the last of the reciprocating engine boats. We see that the speed has increased from 22.5 knots to 29.3 knots, the boiler pressure from 250 to 300 pounds, the indicated horsepower from 1,720 to 8,000, and the high-pressure cylinder from 11½ inches to 23 inches diameter. There is no doubt but what with the present-day methods of lubrication and other improvements of design, such as superheat, etc., destroyers of higher speeds could be built using reciprocating engines, but the improvement would not be great and the destroyer had just about reached its limitation as to speed.

Up to this time torpedo boats and destroyers had been regarded as coast and harbor defense vessels and long-distance cruising had not been carried out by them. The ordinary method of operation was to make short runs at high speed from a base, but in 1904 two of these boats, the *Preble* and *Paul Jones*, were sent to Panama to act as despatch vessels, and later in the year a flotilla of destroyers was sent from the Atlantic coast to the Asiatic station, via the Mediterranean. Both cruises proved conclusively that the destroyer was a reliable sea-going vessel and had a cruising radius that compared favorably with other types of ships. The fuel economy at low speeds was the greatest surprise of all. At that time so little was known regarding the fuel consumption at cruising speeds that when the cruise from San Francisco to Panama was first projected arrangements were made for coaling at San Diego and every few hundred miles from there to Panama. Great was the surprise when it was found that the trip could easily be made with only one stop and without any stop by taking a small deck-load of coal.

Adoption of the Turbine for Propulsion

The next step in destroyer design was the change to turbines for propulsion, and with this came the use of forced feed for lubrication. The first vessels to have this type of machinery were the *Smith* class, which were built in 1909. The following table gives the characteristics of these boats:

Length	293 feet 10½ inches
Beam	26 feet 4½ inches
Draft	8 feet ½ inch
Displacement	716 tons
Speed	28.35 knots
Shaft horsepower	9,946
Revolutions per minute	724
Number of screws	3
Boilers	4 Mosher
Total heating surface	18,003 square feet
Total grate surface	368.5 square feet
Ratio of heating surface to grate surface	48.86 to 1
Fuel, coal	304 tons
Cruising radius at 16 knots	2,800 knots



Fig. 3.—The *Cushing*, With a Displacement of 91.34 Tons and an Indicated Horsepower of 1,720, Developed a Speed of 22.5 Knots

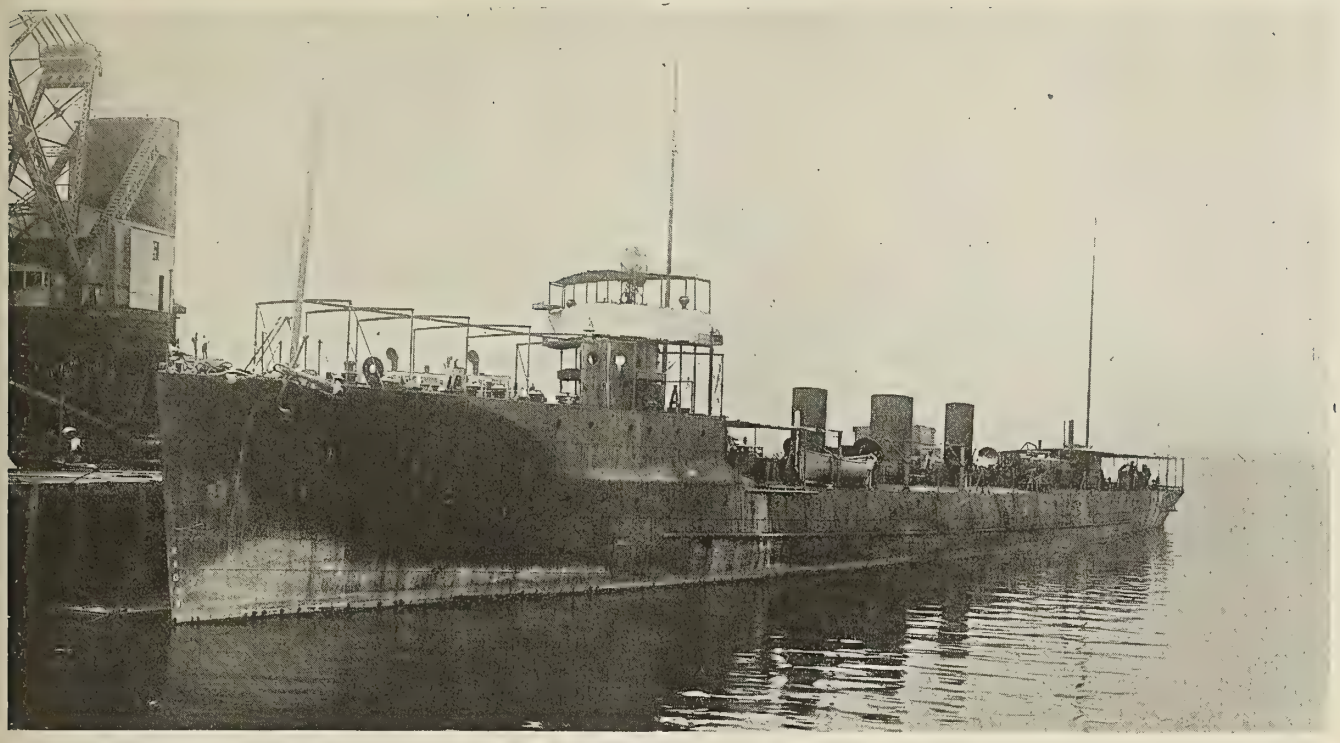


Fig. 4.—Destroyer *Roe*, Built at Newport News in 1910; Trial Speed, 29.60 Knots

With previous destroyers fitted with reciprocating engines it had been difficult to obtain machinery that would be reliable for high-speed runs for any considerable period of time. The difficulty was so great that most of the early destroyers were required to run full-speed trials of one-hour duration only. As soon as turbines were adopted, the trial requirements were immediately raised to four hours. The destroyer, being a high-speed boat, requires high speed of revolutions of the screw, and this condition, while ideal for turbines, is a very severe test for reciprocating engines. There is no doubt but what the destroyer was the main factor in developing turbines for marine purposes, as it presented a case where turbines were fairly well suited for the purpose without any great change from conditions on shore. This was not the case with battleships and other vessels having slow-speed screws, and the progress of turbines for marine propulsion would doubtless have been very slow if it had not been for the destroyers.

Blower Troubles Eliminated by Turbine Drive

Up to this time the forced draft blowers of destroyers had all been driven by light, high-speed, reciprocating engines and they were subject to the same troubles as were the main reciprocating engines, except that the troubles were exaggerated in the smaller engines. It was only natural, therefore, to adopt the turbine for driving the blowers as well as the propellers. It is no exaggeration to say that this change was almost as great an improvement as the adoption of the turbine for propulsion, as more breakdowns and failures on trials were due to blower trouble than to all other causes.

The first turbine-driven destroyers solved the problem of reliable high-speed machinery, but there was very little saving in weight, owing to the complications that were necessary to obtain reasonable economy at low speeds. In the fight between the turbine and reciprocating engine for supremacy in the field of marine propulsion it has always been the comparatively poor economy of the turbine at low speeds that has held it back. The accompanying sketches (Figs. 6-18), giving the machinery arrangements of all our turbine-driven destroyers from the *Smith* and *Lamson* up to the present time, show the progressive steps that have been taken in the evolution of the turbine for destroyer propulsion, and it will be seen that it has been a constant struggle to simplify the machinery and keep down the weights and at the same time provide a reasonable cruising radius at the slow speeds. We have had all combinations of direct-connected cruising turbines, direct-connected cruising reciprocating engines, and geared cruising turbines.

Oil Fuel Displaces Coal

The next advance in destroyer engineering was the substitution of oil fuel for coal. The advantages of this fuel were greater for destroyers than for other vessels, so it was adopted for this class of vessel at the earliest possible moment. The ability to run without making smoke, to

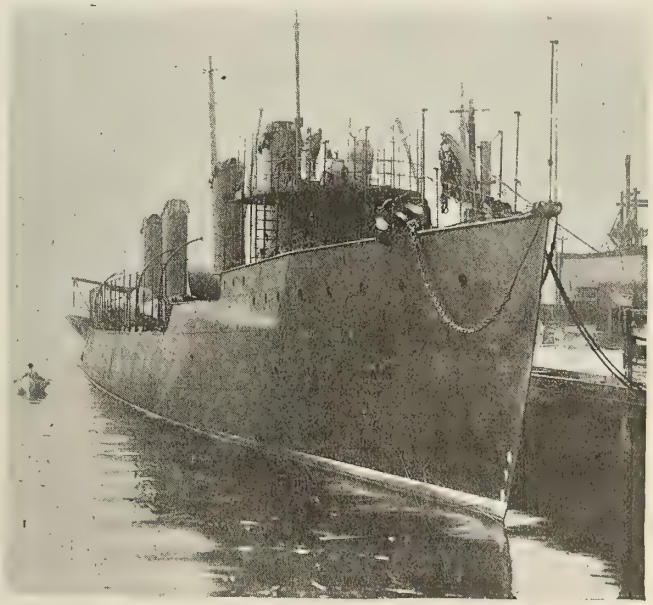


Fig. 5.—*Chauncey* Class Destroyer (1900-1902)

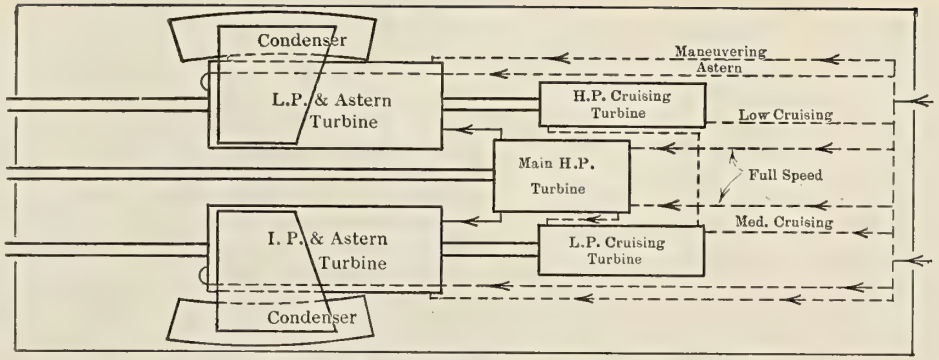


Fig. 6.—Parsons Turbines: *Smith* Class (Twenty Vessels)

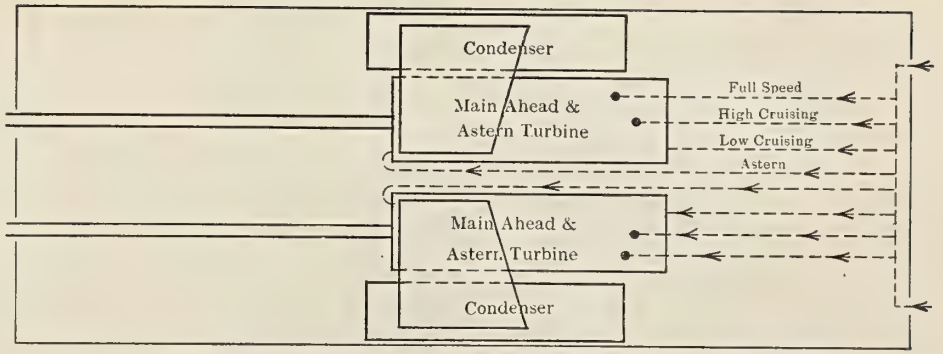


Fig. 7.—Curtis Turbines: *Perkins, Sterett, Walke.* Zoelly Turbines: *Warrington*

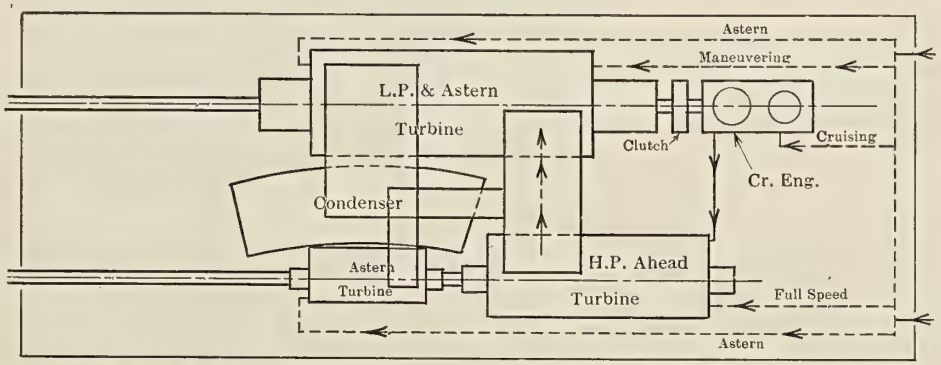


Fig. 8.—Parsons Turbines: *Cassin, Cummings, McDougall, Ericsson*

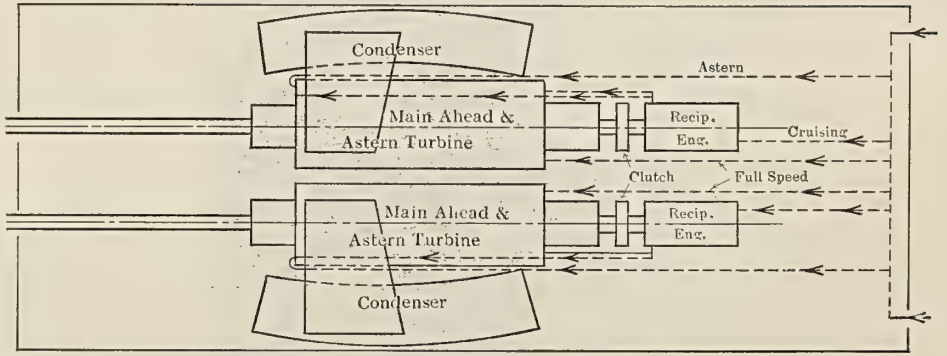


Fig. 9.—Curtis Turbines: *Downes, Duncan.* Cramp's Turbines: *Aylwin* Class (Seven Vessels)

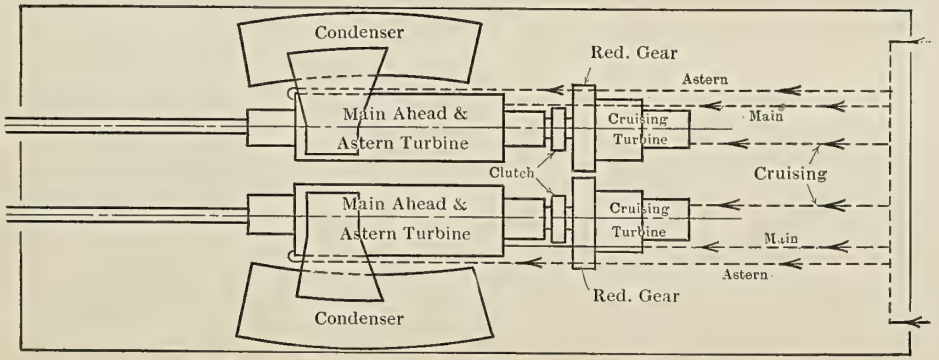


Fig. 10.—Curtis Turbines: *Cushing, Tucker, Sampson, Rowan*

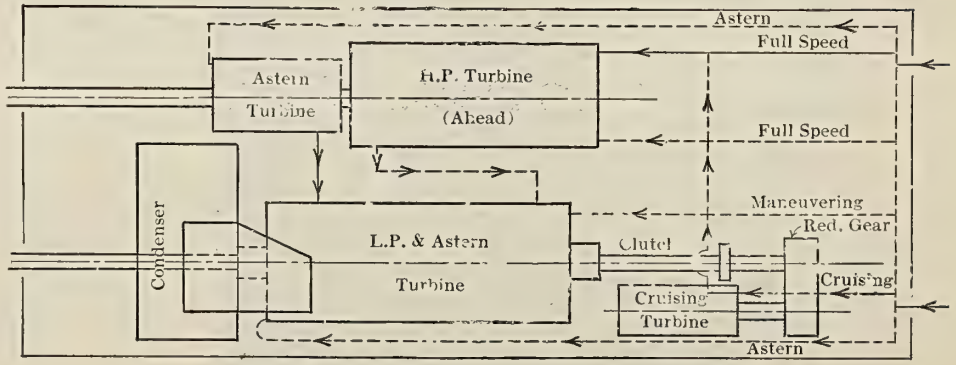


Fig. 11.—Parsons Turbines: *Conyngham, Porter, Wilkes*

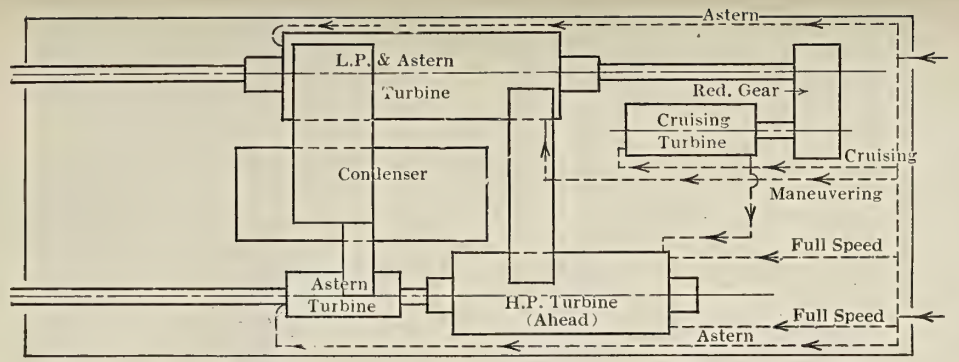


Fig. 12.—Parsons Turbines: *Jacob Jones, Wainwright, Davis, Allen, Shaw*

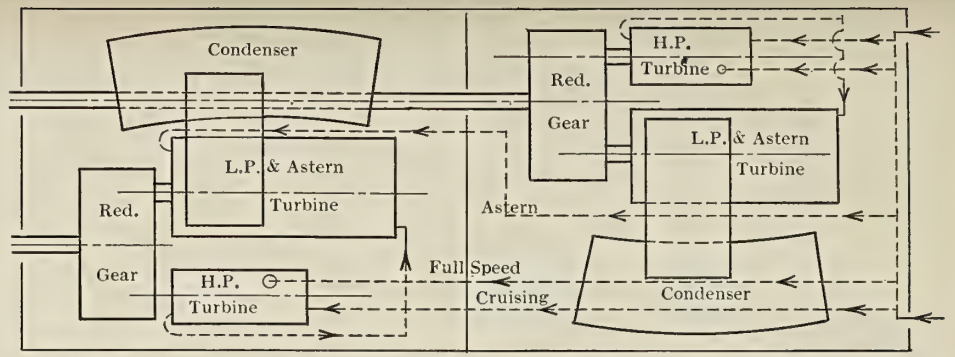


Fig. 13.—Parsons Turbines: *Wadsworth* Class (89 Vessels). Westinghouse Turbines: *Wadsworth* Class (40 Vessels)

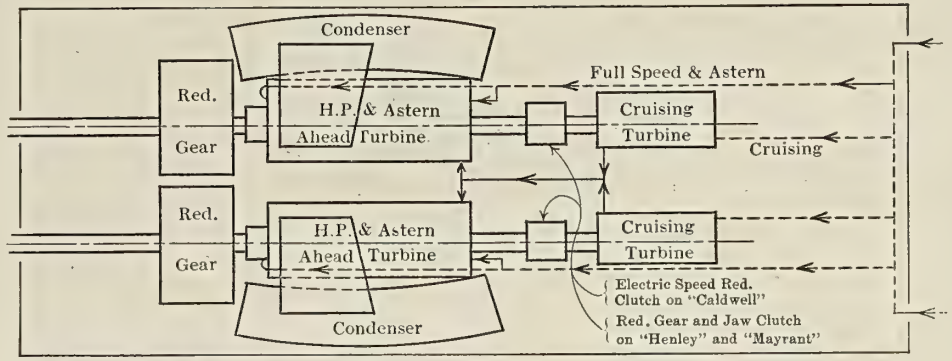


Fig. 14.—G. E. Curtis Turbines: *Caldwell.* Westinghouse Turbines: *Mayrant, Henley*

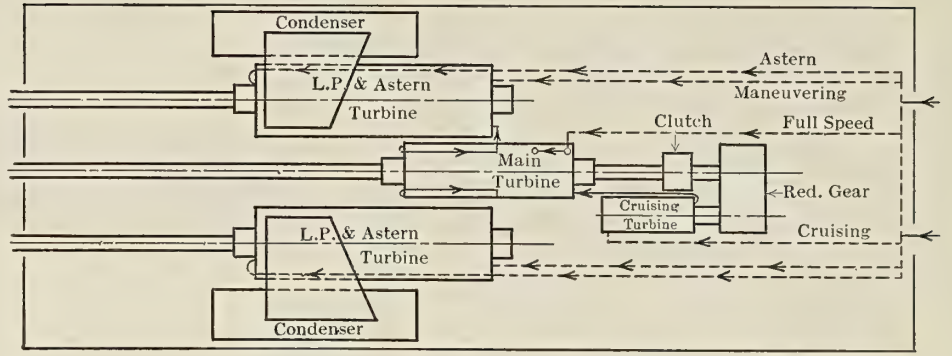


Fig. 15.—Parsons Turbines: *Conner, Stockton*

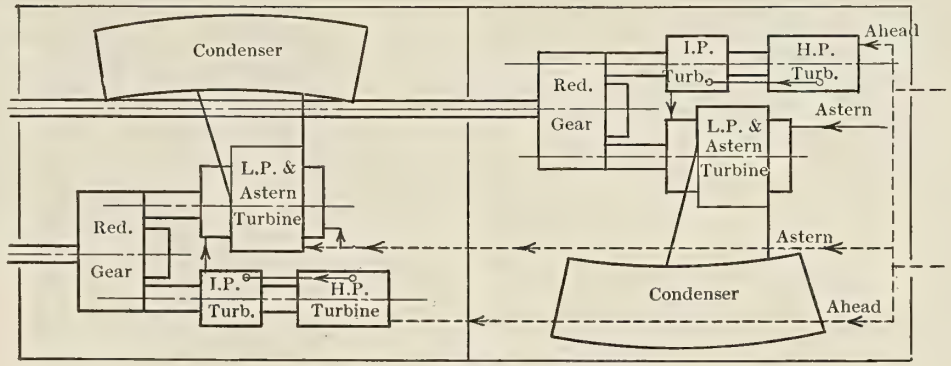


Fig. 16.—Curtis Turbines: 91 Vessels

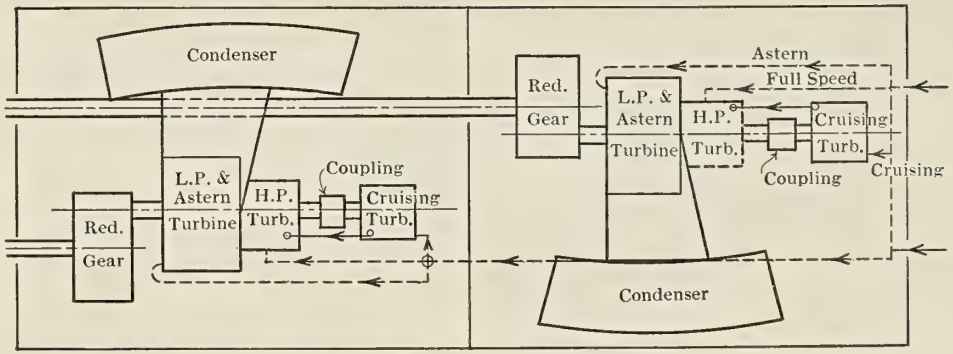


Fig. 17.—G. E. Curtis Turbines: 46 Vessels

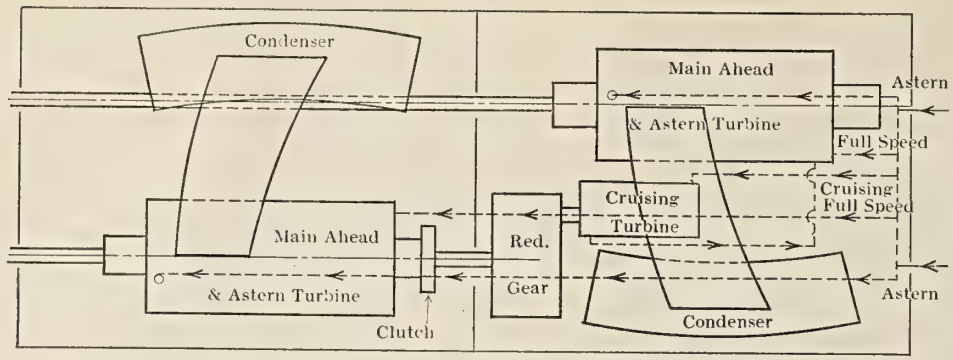


Fig. 18.—Curtis Turbines: 11 Vessels

maintain full power till the fuel is exhausted and to go quickly from low speed to full speed, all are ideal conditions for a destroyer. When the increased facility of refueling (including the ability to refuel at sea) and the increased cruising radius are added to the above advantages, it becomes apparent that the destroyer did not really fulfill its requirements until it was given oil as a fuel.

The *Paulding* class comprised the first oil-burning destroyers and they were built in 1910. The following table gives their principal characteristics:

Length	293 feet 10½ inches
Beam	26 feet 4½ inches
Draft	8 feet 1¾ inches
Displacement	711 tons
Speed	32.8 knots
Shaft horsepower	17,393
Revolutions per minute	903
Number of screws	3
Boilers	4 Normand
Total heating surface	19,321 square feet
Fuel oil	241 tons
Cruising radius at 16 knots	3,000 miles

While the propeller speeds of the destroyer were such as to allow better turbines than in the case of other ships, the speeds were not high enough for the best turbine practice, and in the attempts to improve this condition the propeller speeds used were considerably higher than should have been to get the best propeller efficiency. It was therefore natural to turn to the reduction gear as soon as it became sufficiently developed for the purpose. Here again the destroyer was the pioneer and led the way in the use of the mechanical reduction gear. This was natural, since the speed reduction was not nearly so great as with other types of ships (being only about 5 to 1), and therefore was a very much easier problem to solve; also the advantages gained were much greater than with other types of ships, owing to the great advantages of weight saving in this type of vessel.

Reduction Gears Applied to Main Propelling Units

The *Wadsworth*, built in 1915, was the first vessel to be fitted with reduction gear for the main unit. The following table gives the general characteristics of the vessel:

Length	310 feet
Beam	29 feet 8½ inches
Draft	9 feet 4½ inches
Displacement	1,050 tons
Speed	30.7 knots
Shaft horsepower	16,100
Revolutions per minute	460
Number of screws	2
Boilers	4 Normand
Total heating surface	21,500 square feet
Fuel oil	326 tons
Cruising radius at 16 knots	5,640 knots

The arrangement of the machinery of the *Wadsworth* is shown in Fig. 13, and it will be noted that it is very simple, consisting of a high-pressure and a low-pressure turbine driving pinions meshing with the same gear, there being only two gears and two main shafts. The *Wadsworth's* machinery contains several novel features. The gear is a single helical gear and is arranged to take part of the propeller thrust direct and transmit it to the turbines, where it is balanced by steam pressure; the re-

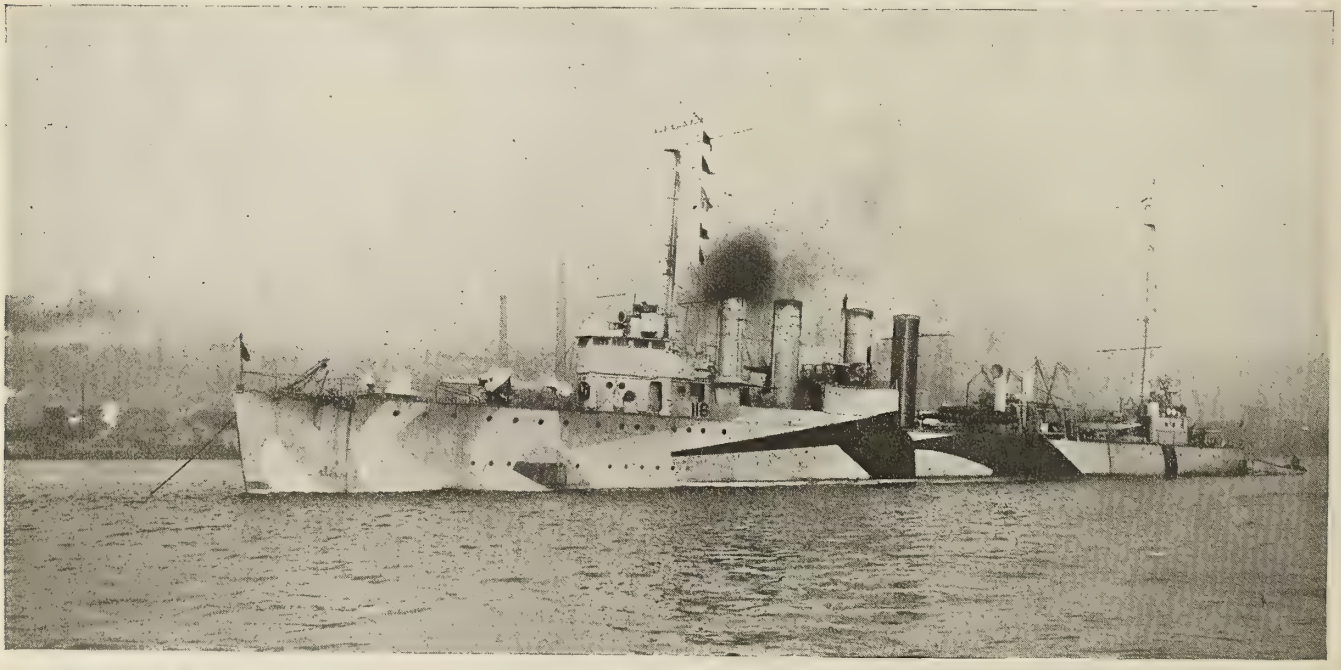


Fig. 19.—U. S. S. *Dent*, Latest Type American Destroyer; Displacement, 1,159 Tons; Shaft Horsepower, 28,190; Speed, 36.88 Knots

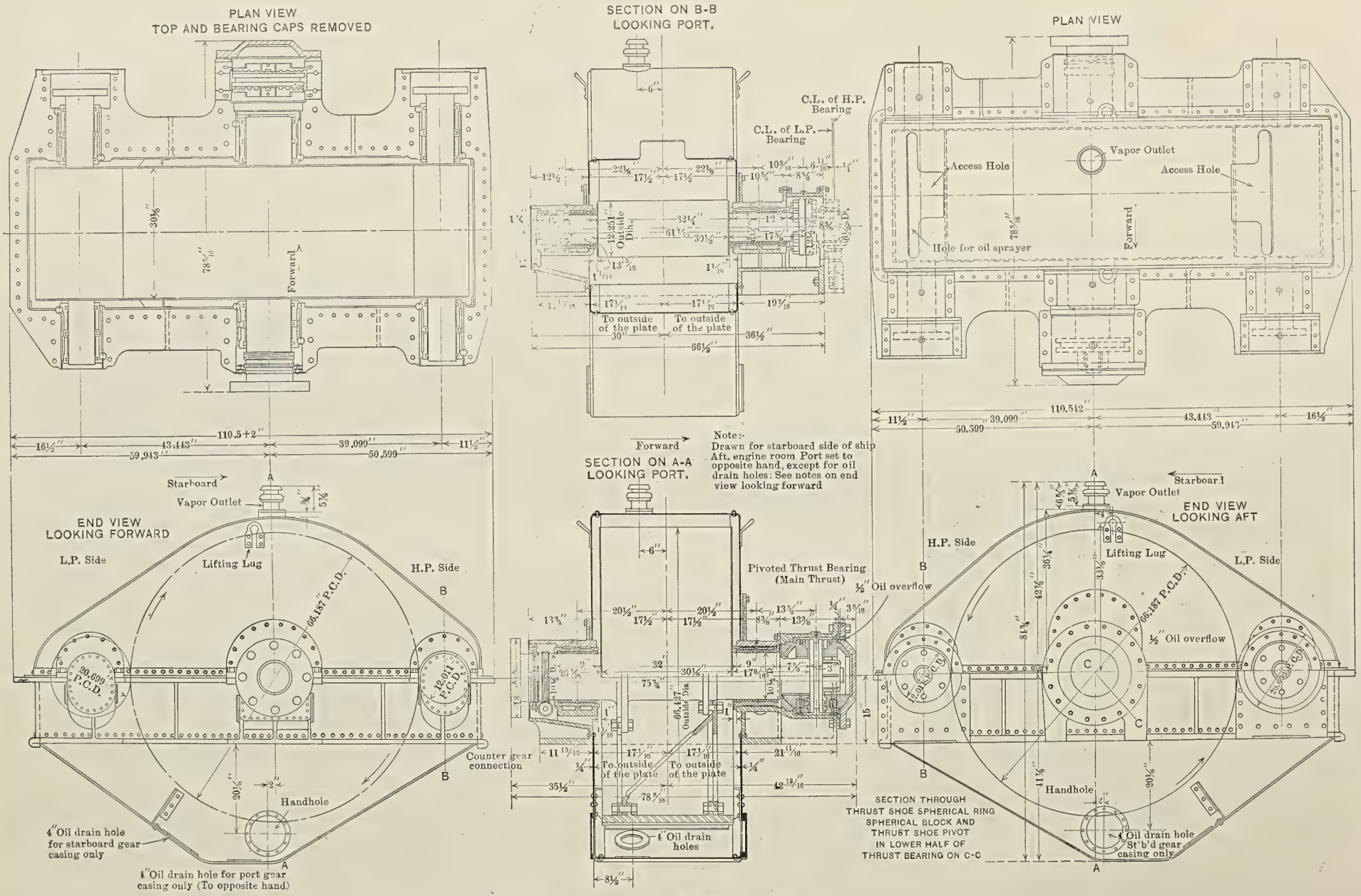


Fig. 20.—Details of Reduction Gears

mainder of the trust is taken by a thrust bearing which is of the pivoted segmental (Kingsbury) type. This was the first use of this type of thrust bearing in the navy, but its use has since become practically universal. The single helical gear has not been used in the later destroyers, which are of much greater horsepower (requiring longer pinions), but it has proved very satisfactory on the *Wadsworth*.

The *Wadsworth* really marked the end of the era of direct-connected turbines, although several destroyers were built after this date with direct-connected turbines. During the war it was not possible to obtain gears in such great numbers as they were needed, so a certain number of direct-connected turbines were installed. These reached a high degree of perfection in the boats turned out by Newport News Shipbuilding & Drydock Company, as these boats made over 35 knots on their full power trials.

Boiler Capacity Increased to Obtain Higher Speeds

The next step in the evolution of the destroyer was to increase the speed by a large increase in boiler capacity. These boats were built during the war under great pressure and various expedients were considered in the hope of expediting production. It was even considered reducing the speed, reducing the number of boilers, etc., but none of these offered any hope of greatly increased production, so it was decided to build the best boat possible under the conditions. The data on this class of vessel are given in the first page of this article in comparison with the *Cushing*.

The propelling machinery is located in two separate compartments, one forward of the other. It consists of geared turbines of the Parsons type, there being a high-pressure and low-pressure turbine in each engine room; the high- and low-pressure turbine pinions mesh with one gear, which is on the propeller shaft. The backing turbine is located in the after end of the low-pressure turbine casing. The high-pressure turbine was designed to run at 2,988 revolutions per minute, and the low-pressure turbine at 1,775 revolutions per minute, for a shaft speed of 436 revolutions per minute, giving a reduction for the high pressure of 6.85 and a reduction for the low pressure of 4.07. The high-pressure turbine is arranged with two connections for live steam, one being for cruising and the other for full power. The turbine thrust is taken by two 9-inch Kingsbury thrusts.

Construction of Reduction Gear

Fig. 20 shows the general arrangement of one of the gears. Each reduction gear consists of two double helical pinions meshing into a single gear. The pinions are of nickel steel; the gear rims are carbon steel forgings and the gear centers are cast steel. The high-pressure pinion has a pitch diameter of 9.91 inches, the low pressure a diameter of 16.69 inches, and the gear a diameter of 67.96 inches. The total length of tooth face is 37⅞ inches The spiral angle of the teeth is 39 degrees 53 minutes. The high-pressure pinion has 41 teeth, the low pressure 69 teeth, and the gear 281 teeth. The oil for lubricating the gears is taken from the forced lubrication system and is supplied through spray nozzles. The main thrust bearing is a 21-inch Kingsbury bearing with its housing built into the gear casing.

The boiler plant consists of four White-Forster boilers arranged in two watertight compartments. The boilers have a total heating surface of 27,000 square feet. Each boiler has an independent smoke pipe 20 feet high above the main deck. The boilers are designed to burn oil fuel on the mechanical pressure atomization principle.

The oil-burning equipment consists of two light-service booster pumps, four heavy-pressure duplex service pumps, and two oil heaters. Half of this is located in each of the two firerooms. The booster pumps take a suction from the storage tanks and deliver to the service pumps, which deliver oil to the burners through the oil heaters. Oil is supplied at a pressure of about 250 pounds per square inch. A small hand-pump is located in each fireroom for raising steam. Air for combustion is supplied at a pressure of about 8-inch water pressure by six vertical turbine-driven blowers, three being in each fireroom.

Destroyer Approaching Scout Cruiser Type

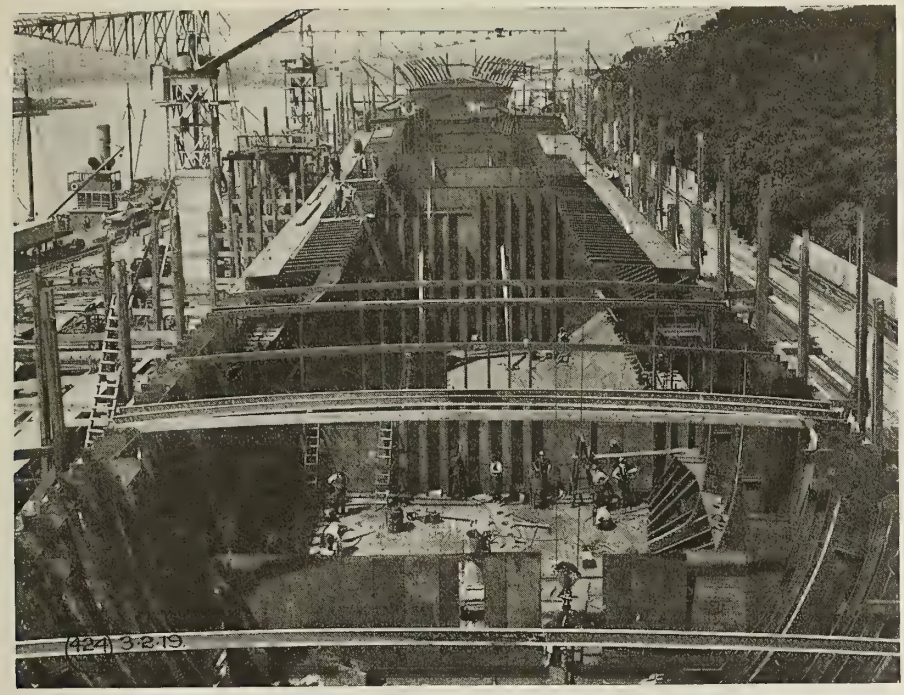
The present destroyer, in size and speed, approaches very closely to the scout cruiser, and it is very probable that the latter will be displaced by destroyers of somewhat greater tonnage than the *Dent* class and which will have considerably more speed than the scout cruiser. The tendency is toward a merging of the two types. However, it is too much to expect that the development of the destroyer will continue at the same rapid pace that it has set during the past five years of war.

10,000-Ton Collier Built in Australia

THE British auxiliary collier *Biloela* was launched in April, 1919, at the Commonwealth Naval Dockyard, Sydney, Australia. She is the largest of the ships constructed in Australia, and is the first to be entirely built with materials fabricated in the Commonwealth. When loaded to capacity, the *Biloela* displaces 10,000 tons, which is about 2,200 tons greater displacement than any ship previously built in Australian yards. The collier was completed in five and a half months, which is a creditable performance considering the fact that labor troubles and delays of material were experienced continually. Previous to this attempt the establishment at Sydney had constructed the cruisers *Brisbane* and *Adelaide*, both ships requiring a great degree of care in the structural fitting. As a result of this experience the same care was put into



Launching of Collier *Biloela* at Naval Dockyard, Sydney, April 10, 1919



H. M. A. Collier *Biloela* Three and a Half Months After Laying of Keel

the building of the *Biloela,* so that she is an example of fine workmanship throughout.

Special features of construction distinguish the *Biloela* from the ordinary tramp or freighter, which fit her for duties as a coal, oil and fresh water carrier for the ships of the auxiliary fleet. The coal is carried in self-trimming holds, designed to facilitate the use of grabs. Oil is contained in the double bottom and in hold tanks, while the fresh water is carried in topside tanks.

The *Biloela* has a length of 382 feet overall, a beam of 54 feet and a draft when displacing 10,000 tons of 22 feet 6 inches. She is of the single deck type, with a deadweight carrying capacity of 7,000 tons. Her holds are arranged to carry 6,465 tons of coal, while the bunkers have a capacity of 1,007 tons. If oil is to be carried, the tanks provide space for 1,068 tons. Her water tanks will hold 662 tons. In addition to her equipment as a collier, modern cargo handling machinery is installed so that the ship may be converted into a general carrier for the coast trade. There are four main holds unobstructed by pillars, with hatches, 30 feet by 32 feet 6 inches. Eleven derricks, each of five tons capacity, are operated by steam winches. When handling 1½ tons of coal contained in bags, the speed of lifting is 250 feet per minute. Her hull is particularly strong and includes a ¾-inch tank top, enabling the ship to carry a concentrated cargo without danger of unduly straining the structure.

Her accommodations compare favorably with the best of the ocean-going cargo vessels. The captain and deck officers are amidships, while the chief engineer and crew have quarters aft under the poop.

With the exception of a few thin plates, all the the steel used in the vessel was rolled in the works of the Broken Hill Proprietary Company, Limited, Newcastle. The equipment of this plant was not designed for rolling ship plates, but the results obtained were entirely satisfactory, although the plates were somewhat smaller than had been originally intended.

The machinery for the *Biloela* was constructed at the Sydney yard, according to the best practice for this type of vessel. Her propelling machinery consists of an inverted triple expansion engine having cylinder diameters of 26 inches, 41½ inches, and 67 inches, with a stroke of 48 inches. It is capable of developing 2,500 indicated horsepower under normal conditions. Steam at 180 pounds per square inch pressure is generated in four watertube boilers of the Babcock & Wilcox type having a heating surface of 9,600 square feet and a grate area of 233 square feet. Air is supplied on the Howden principle of forced draft, and will burn fuel of low calorific value and with a high percentage of ash efficiently. Brickwork for the boilers is standard, so that it may be easily renewed. Sufficient steam space is provided, so that priming in the boilers is unnecessary. A return flow condenser, having a surface of 2,300 square feet, provides ample capacity for the exhaust steam.

An Edwards air pump, 2 feed and 2 bilge pumps are driven by the main engines. Steam and hand turning gear are fitted to the engines.

The thrust block is of the Michell design, having but one collar running in an oil bath to take the entire thrust. The propeller is 17 feet 6 inches in diameter, with the same pitch, and has a speed of 70 revolutions per minute. Several new features have been introduced in the machinery of the vessel, and include a safety valve of the full bore type, as fitted in all Admiralty vessels, and a main regulating valve with a superimposed jockey valve.

Auxiliary equipment was built by firms in various parts of Australia. The circulating pump, electrical equipment, evaporators and fan engines were supplied from Melbourne; the main feed and oil fuel pumps, steering engine, bilge and ballast pumps from South Australia; the windlass capstan, ash hoist, coaling winches, general service pump, fresh water pump and forgings for the propeller and crank shafts from Sydney.

The main engine feed pumps draw from the hot well and discharge to the heater. Feed water gravitates from the heater to the main feed pumps, and is thence discharged to the boilers. Filtering is effected between the main engine feed pump and the heater.

As the vessel is designed to carry oil fuel in addition to coal, the main ballast line of piping is adapted to deal with fuel oil in addition to its ordinary duties. Two centrifugal pumps, having a total capacity of 150 tons per hour, are fitted to handle the oil.

Boiler Explosion.—The British Board of Trade has recently issued a report as to a boiler explosion which occurred on February 7 last on board the steamship *Izaston* when about 12 miles north of Yarmouth. The boiler was of the three-furnace marine cylindrical return-tube type, 15 feet 3 inches in diameter by 10 feet 3 inches long, and was built about 20 years ago. When the explosion took place a piece of the combustion chamber back plate close to one of the bottom stays of the center furnace in the starboard boiler was blown out, forming an opening through which the contents of the boiler escaped into the stokehold. The explosion, the report states, appears to have been due to local corrosion on the fire side of the combustion chamber plate. The corrosion was probably caused by leakage from the adjacent stay.



Fig. 1.—Launching a 150-Foot Tug at Moore Plant of Bethlehem Shipbuilding Corporation, Ltd., Elizabeth, N. J.

The Bethlehem Shipbuilding Corporation, Ltd., Makes a World's Record in Shipbuilding

DURING the month of July of this year the Bethlehem Shipbuilding Corporation, Ltd., established a world's record for ship deliveries by completing and delivering to their owners nineteen vessels, consisting of ten 35-knot seagoing torpedo-boat destroyers and two large submarines for the United States Navy, and five large tank steamers and two ocean-going tugs for the United States Shipping Board Emergency Fleet Corporation.

Such a record has never been approached by any other shipbuilding company in the United States or Europe. During the same month all of the other American shipyards combined, some thirty-five, delivered only sixty-seven vessels, including destroyers and submarines, or an average of less than two ships per yard. The largest number of vessels delivered during the same period by any other single corporation was only eight ships, while from all the other yards building naval vessels but three destroyers and one submarine were delivered.

When it is understood that all the engines, boilers and deck machinery required for these nineteen vessels were built by the Bethlehem Corporation, as well as the complete hulls, some idea of the magnitude of this accomplishment can be gained, especially when it is realized that for the destroyers alone Curtis turbine engines totaling over a quarter of a million shaft horsepower were constructed, and also the Yarrow type watertube boilers necessary to generate the steam for this enormous horsepower.

The fact must not be overlooked that it was necessary for every piece of material used in building these vessels to pass the rigid government inspection, which, in the case of destroyers and submarines, is the most exacting inspection known, and each vessel successfully underwent the severe government trials before being accepted for delivery.

To supply the shipyards with the steady flow of material necessary for the accomplishment of such rapid construction was in itself a record, as over 78,000 tons of material were used.

The building of these vessels was carried out on a regular eight-hour schedule and not under highly intensified war production conditions, so that the large number of deliveries seems all the more remarkable and can give some idea of what our country was preparing for the Hun submarines during 1919, as under war conditions these deliveries would have been materially increased.

The scientific construction of seagoing 35-knot torpedo-boat destroyers has been so efficiently developed by the Bethlehem Shipbuilding Corporation, Ltd., that a destroyer has been completely built and delivered to the Government in 174 working days. To build such a vessel before the war required approximately one and a half years.

July is a month of records for the Bethlehem Shipbuilding Corporation, Ltd., for in July of last year the

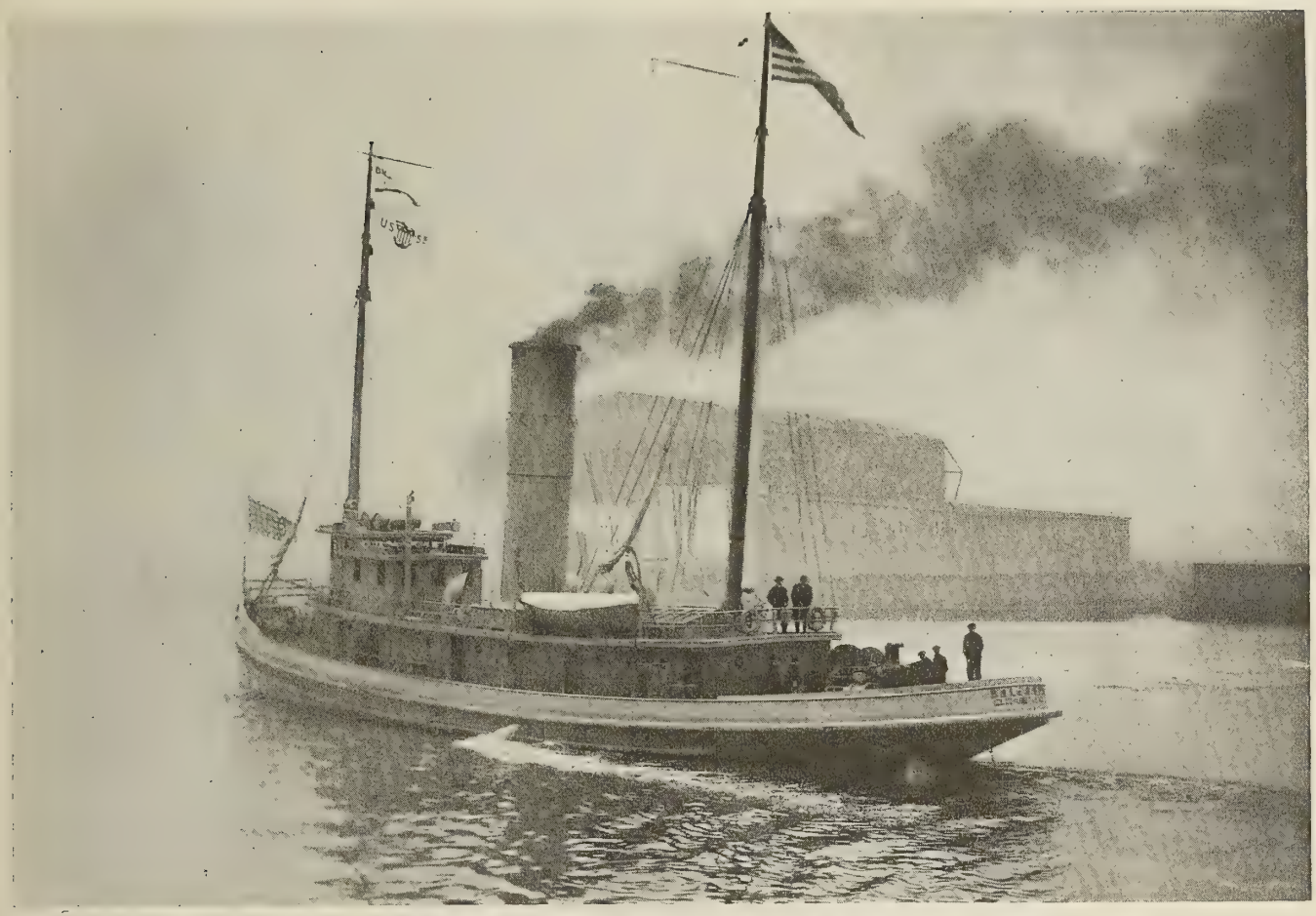


Fig. 2.—Trial Trip of Tug *Baleshed*, March 7, 1919

Union plant of this corporation, located at San Francisco, launched a 12,000-ton freight steamer—the *Invincible*—in 23 working days and 23 working hours, and delivered this vessel in 66 working days from the laying of the keel, establishing another world's record, as over 13,500 tons of steel were fabricated and over 1,000,000 rivets were driven in the building of this ship.

At the present rate the Bethlehem Shipbuilding Corporation, Ltd., would deliver over one-fourth of the steel vessels completed in America this coming year, and two and one-half times as many vessels as any other shipbuilding company. Such production can only be obtained by a highly efficient organization having at its disposal the most up-to-date facilities for the manufacture of all articles needed in the construction of ships. The coordination of all the Bethlehem shipbuilding interests in one central office at Bethlehem has made such an organization possible.

Merchant Shipbuilding in the World.—Lloyd's returns show that on June 30, 1919, there were 2,526 merchant vessels (each of 100 gross tons or over), aggregating 8,017,767 gross tons, under construction in the world's shipyards. Before the war the largest tonnage under construction in the world was 3,445,000 gross tons on June 30, 1913. On that date merchant ships under construction in the shipyards of the United Kingdom numbered 543 of 2,003,241 gross tons. On June 30 of this year 994 vessels of 3,874,143 gross tons were under construction in the United States, as against 782 vessels of 2,524,050 gross tons in the United Kingdom. The above figures do not include shipbuilding in Germany, as the figures for that country are not yet available.

Ocean-Going Tugs Built at the Moore Plant of the Bethlehem Shipbuilding Corporation, Ltd.

During this month the last of twenty 150-foot, 11-knot ocean-going tugs contracted for by the United States Shipping Board Emergency Fleet Corporation will be delivered by the Moore plant of the Bethlehem Shipbuilding Corporation, Ltd., Elizabeth, N. J. The first of these vessels was launched on November 20, 1918, and up to the date of going to press with this issue eighteen of the tugs had been launched, with the remaining two scheduled for launching on September 10. The entire contract will be completed this month.

The tugs are 150 feet long overall, 141 feet 3½ inches long between perpendiculars, 27 feet 6 inches molded beam, and 16 feet 8 inches molded depth at the lowest point of sheer. Although the guaranteed speed is 11 knots, it is worthy of mention that in no case has the trial speed been less than 11.25 knots.

Propulsion is by an inverted, direct-acting, triple-expansion reciprocating engine with cylinders 17 inches, 25 inches and 43 inches diameter with a common stroke of 30 inches. The estimated horsepower is 800, but on speed trials 1,000 horsepower has been developed.

Steam is furnished at a working pressure of 180 pounds per square inch by two Scotch boilers, 11 feet 6 inches inside diameter and 12 feet long over the heads, having a total heating surface of 1,550 square feet. Sixteen of the tugs are coal burners and four oil burners.

Nine of the vessels are equipped with a towing bit and steam capstan located at the after end of the deckhouse. The balance are equipped with American and Lidgerwood

ONE HUNDRED AND FIFTY-FOOT, 11-KNOT OCEAN GOING TUG

Built at Moore Plant, Bethlehem Shipbuilding Corporation, Ltd., Elizabeth, N. J.

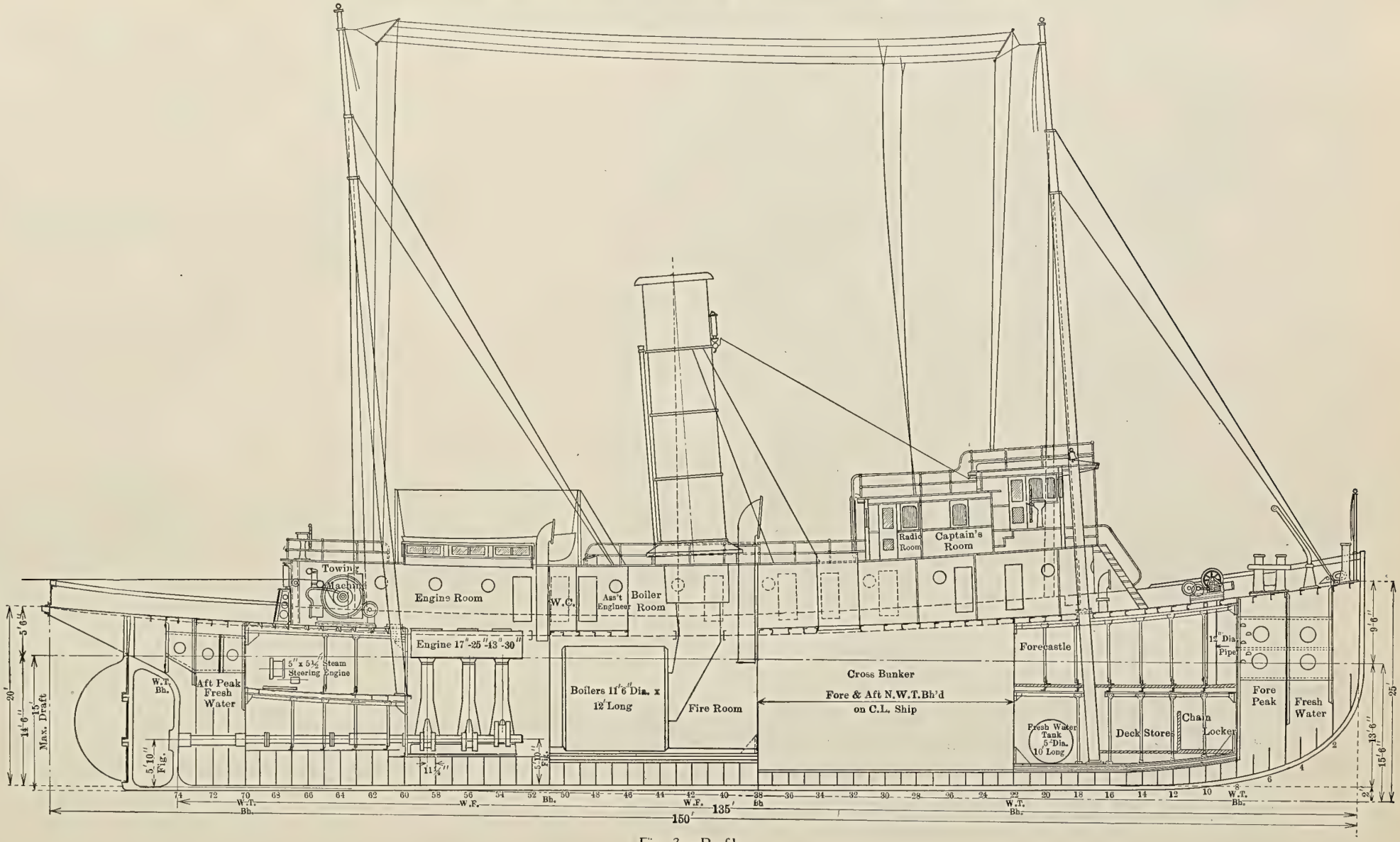


Fig. 3.—Profile

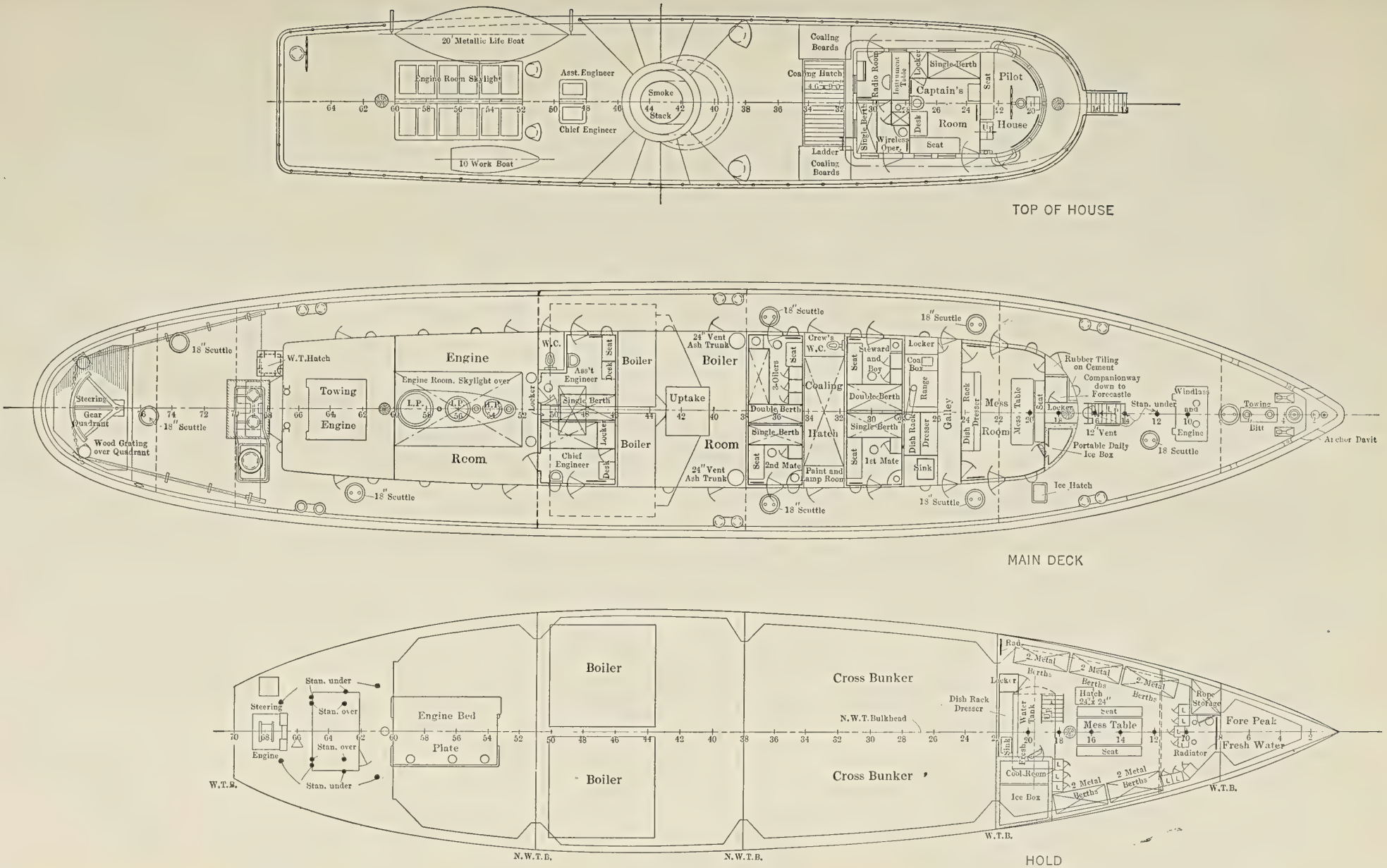


Fig. 4.—Deck Plans

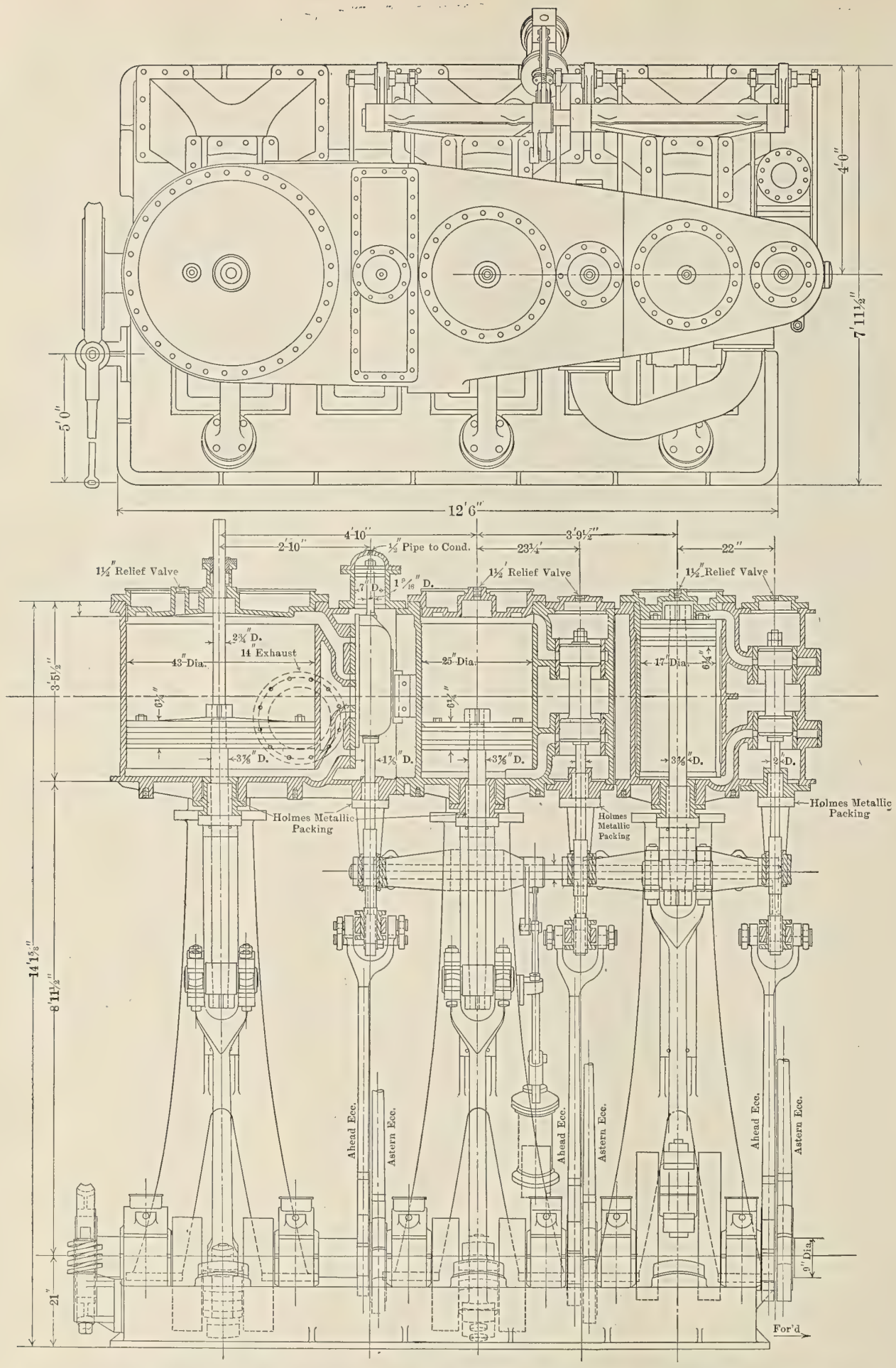


Fig. 5.—Main Engine of 150-Foot Tug; Cylinders, 17, 25 and 43 Inches Diameter by 30 Inches Stroke; Horsepower, 1,000

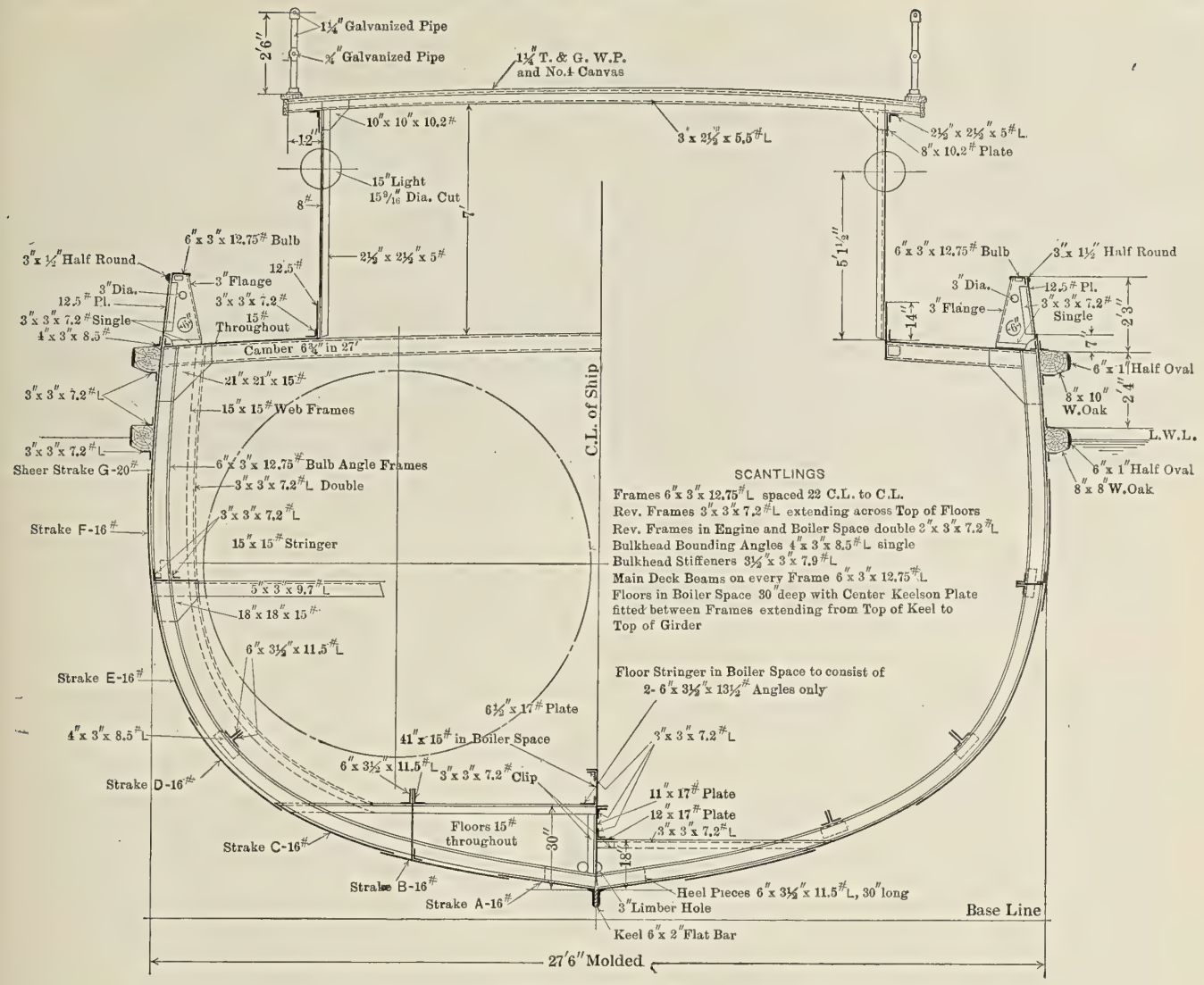


Fig. 6.—Midship Section

towing machines, in addition to the towing bit and capstan. The details of the construction of both hull and machinery of these vessels is shown in the drawings on the preceding pages.

Turning an Auxiliary Condenser Into an Oil Cooler

DURING a recent voyage from Portland, Ore., to New York the S. S. *Anoka,* of the American-Hawaiian Steamship Company, ran through very warm seas, the log book showing sea water temperatures of 88 degrees F. day after day. This condition made it very difficult to keep the lubricating oil cool, especially as the boat was equipped with only one cooler; in fact, the oil entered the cooler at 124 degrees and came out but one degree lower.

As a result of the use of this hot oil the bearings of her turbines grew hotter and hotter, and at last, when they reached 164 degrees, the chief engineer decided that something had to be done. Casting about for a remedy, he conceived the novel idea of transforming his auxiliary condenser into an oil cooler, and this he proceeded to do with the aid of such tools and piping as he had on board. The success of this plan was complete, as the oil temperature was immediately reduced to 103 degrees and the bearings kept in proper condition.

After reaching port, the condenser was boiled out with soda and kerosene (paraffin) and was ready for port operation.

The *Anoka* was built by the Peninsular Shipbuilding Company, Portland, Ore., and has covered 10,000 miles since leaving port. She is equipped with Westinghouse geared turbines. Arthur Sheridan is chief engineer.

Evolution of the Submarine Detector

The instrument known as the hydrophone, which successfully eliminated the submarine as a war factor within the past year, was a development of American brains and research. The detector is based on the principle of sound wave transmission through the water and depends for its direction-getting qualities on the peculiar and heretofore little understood faculty of the human ear to detect the direction of sound by the shifting of sound from one ear to the other.

The apparatus variously described as the detector or listening device was first designed to be hung overboard amidships below the waterline, while the observer was stationed on deck. Later the instrument was fastened to the hull of the vessel and the observer was stationed within the hold, connections leading through the side of the ship. For heavy war conditions a towing device or propeller was invented which dragged the listener through the water astern, where it would not be affected by the noise from the engines of the ship from which it was being worked.



Fig. 1.—Finished Ship *Naiwa*, Loaded and Starting on Maiden Voyage

A Modern Steel Freight Steamship*

Factors Determining Size of Vessel and Type of Propelling Machinery—Details of 8,800 Deadweight Ton, Turbine-Driven Ship

BY D. D. THOMAS†

FOR ships trading between American and European ports, or between other ports, when the one-way voyage is between twelve to twenty days, the sizes of vessels will vary from 5,000 to 12,000 tons deadweight capacity, and the speed to be maintained under ordinary conditions of sea and weather varying from about 9½ knots for the 5,000-ton ship to about 12 knots for the 12,000-ton ship.

The question of the most desirable size and type of ship has recently claimed a great deal of attention from the people who operate ships, and, judging from the papers and articles appearing at the present time regarding the scientific designing of ships, it is clear that the best methods have not always been followed when new construction has been under consideration.

This has been due, in a great measure, to a lack of understanding between the shipowner and the builder. There should be a closer co-operation, as the owner has at his disposal valuable data regarding the operating cost of his ships.

Unfortunately, these data are often not available for the builder who, when asked to bid on new work, may, with luck, hit on a design as good as the owner's best ship;

* From a lecture delivered in the J. E. Aldred series of lectures at Johns Hopkins University, Baltimore, Md.

† Chief engineer, The Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.

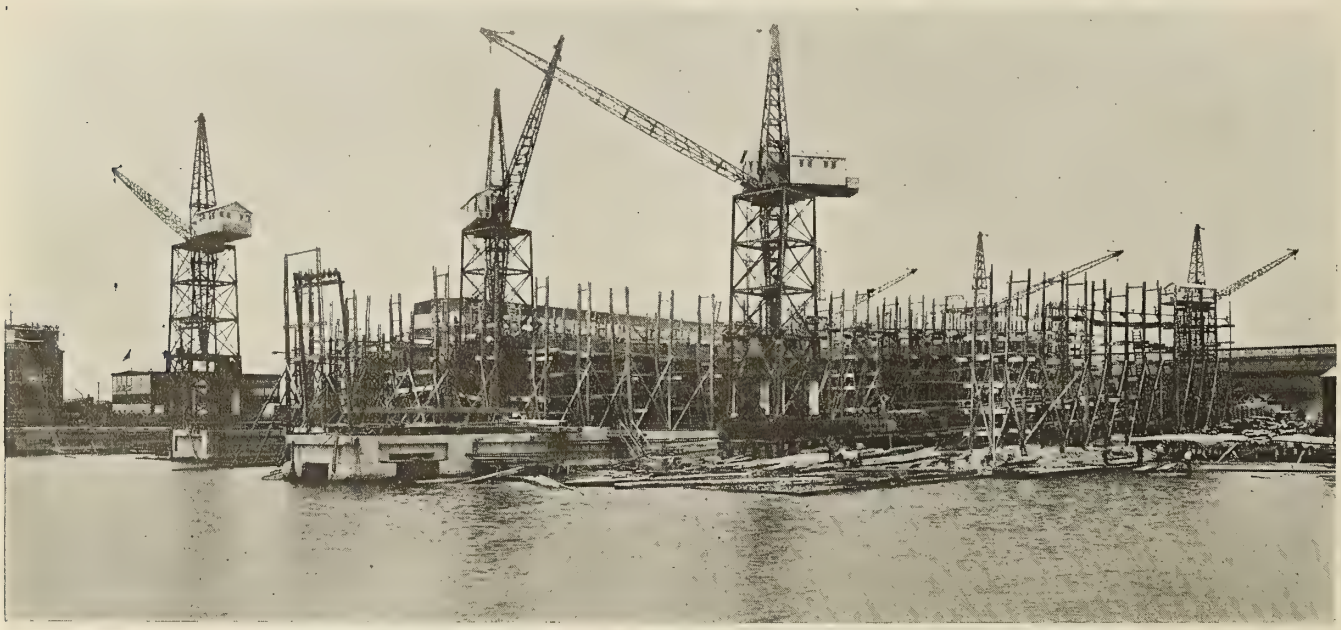
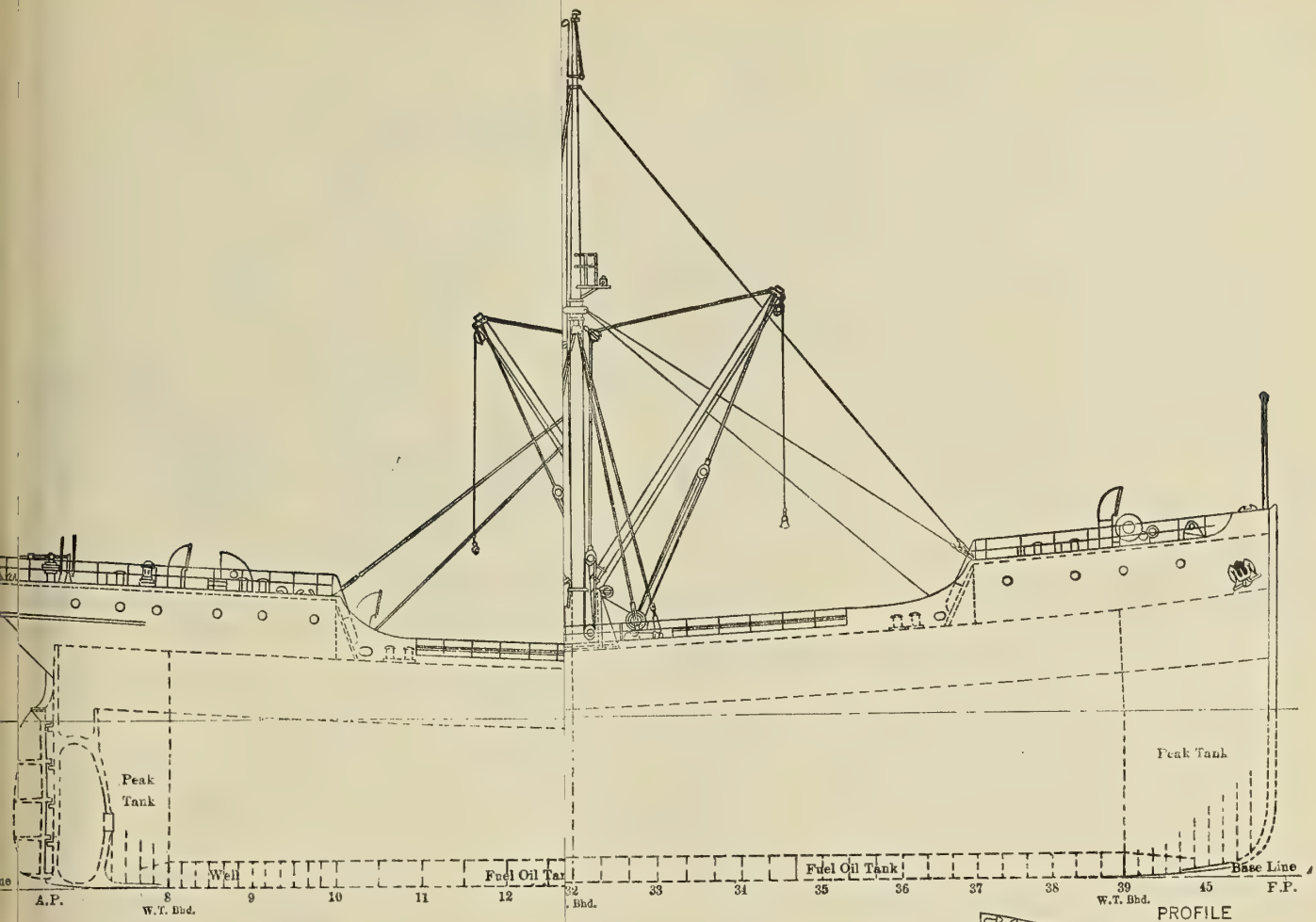
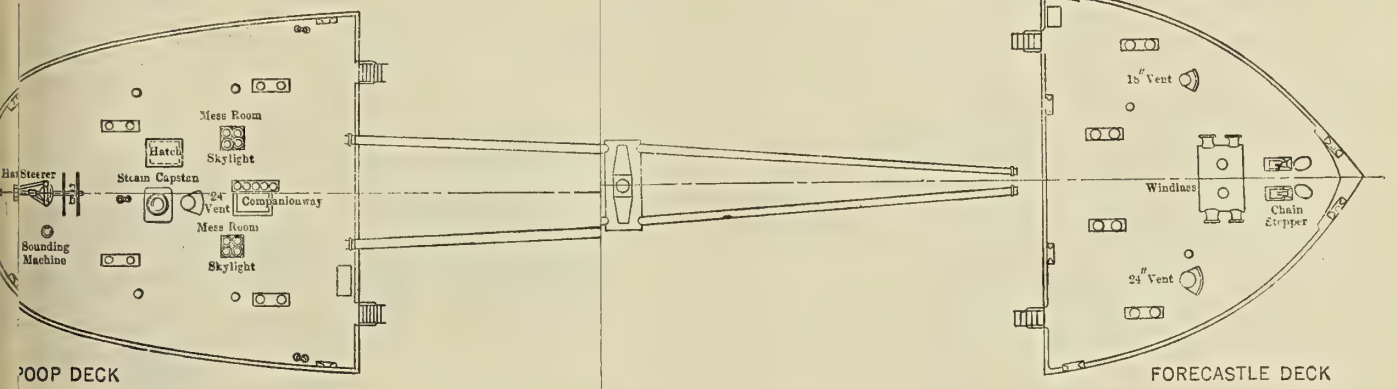


Fig. 2.—Yard at South Plant, Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.

MODERN DEADWEIGHT

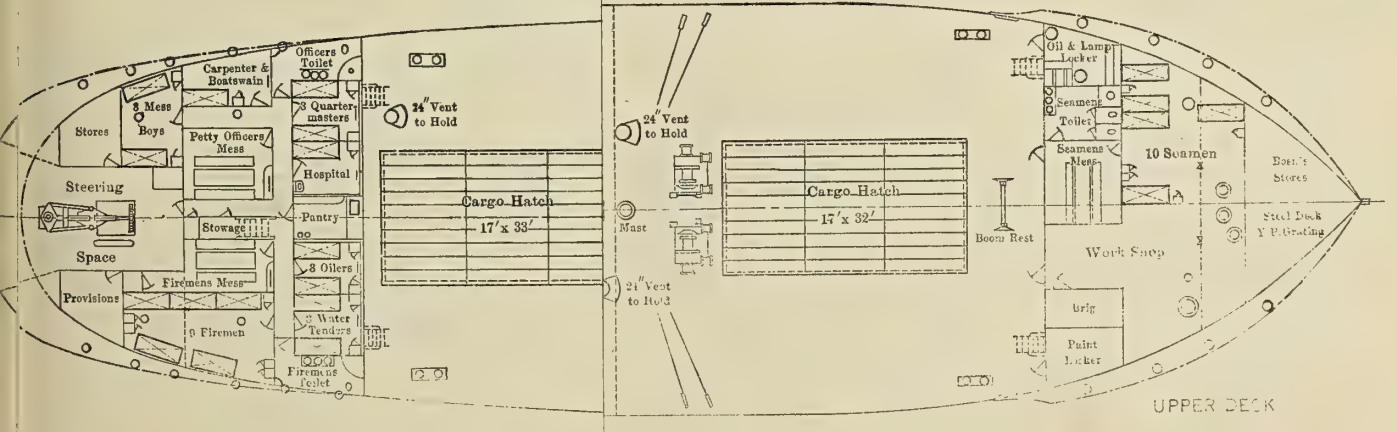


PROFILE



POOP DECK

FORECASTLE DECK



UPPER DECK

MODERN STEEL FREIGHT STEAMSHIP OF 8,800-TONS DEADWEIGHT

Built by the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.

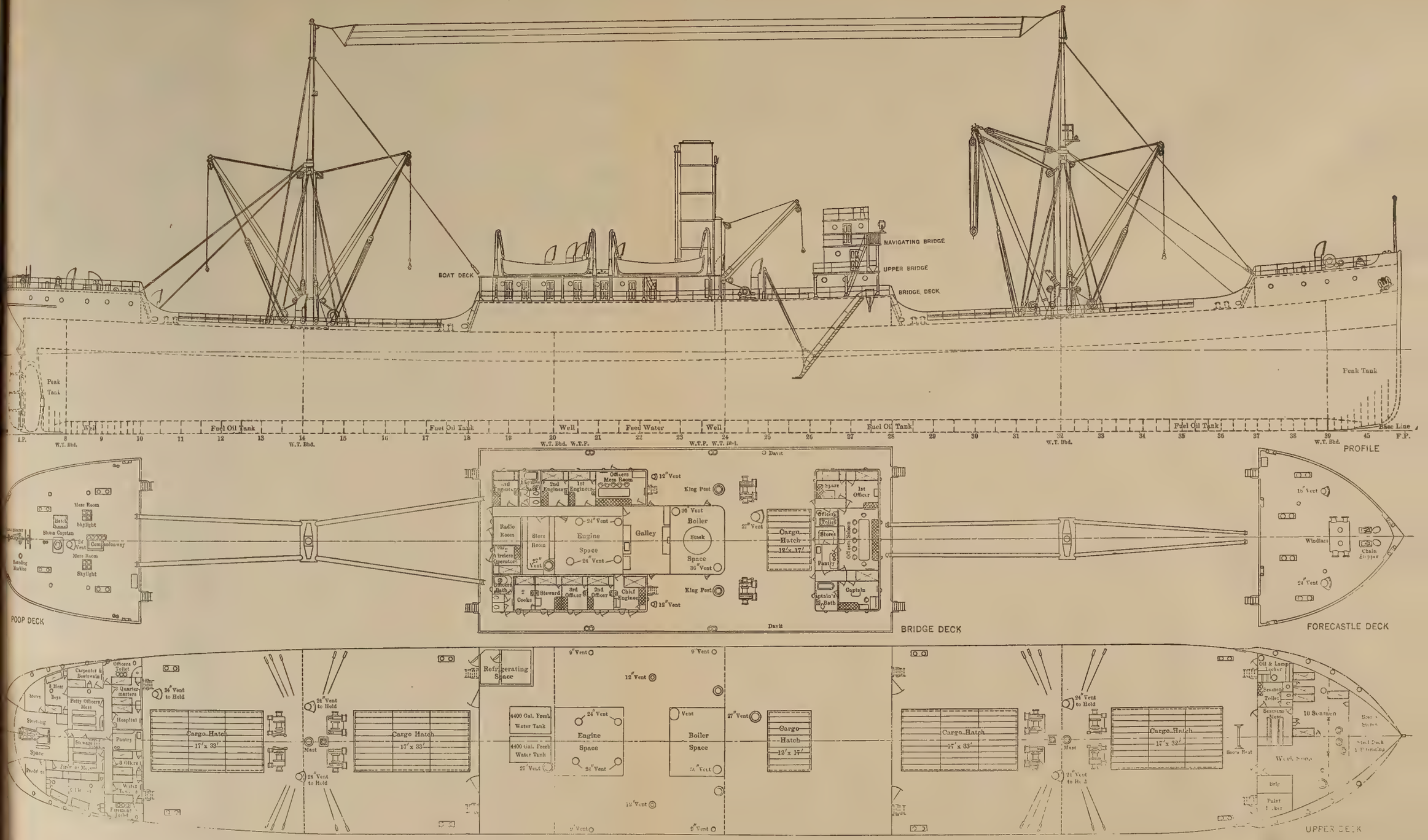
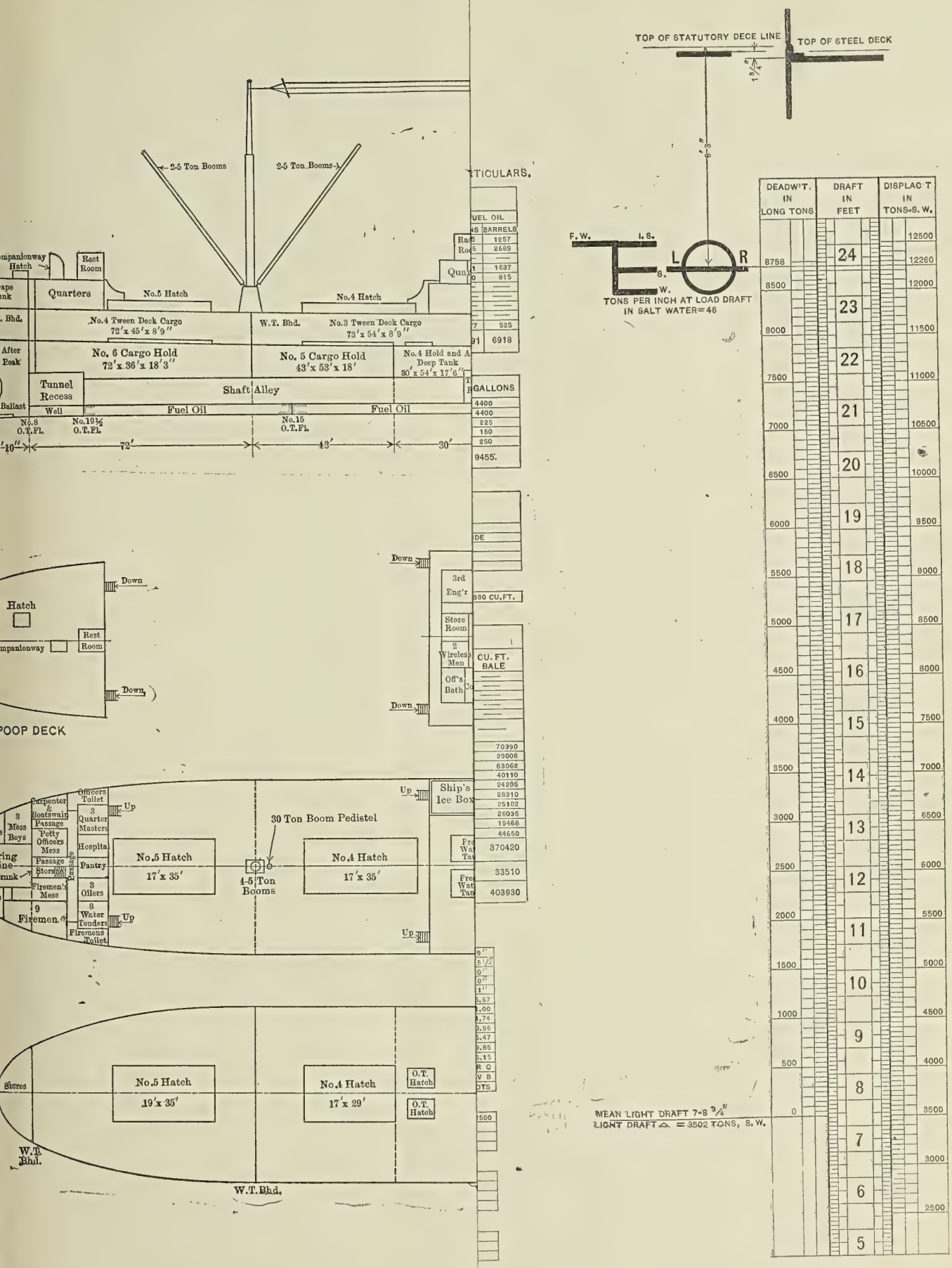


Fig. 3.—Profile and Deck Plans

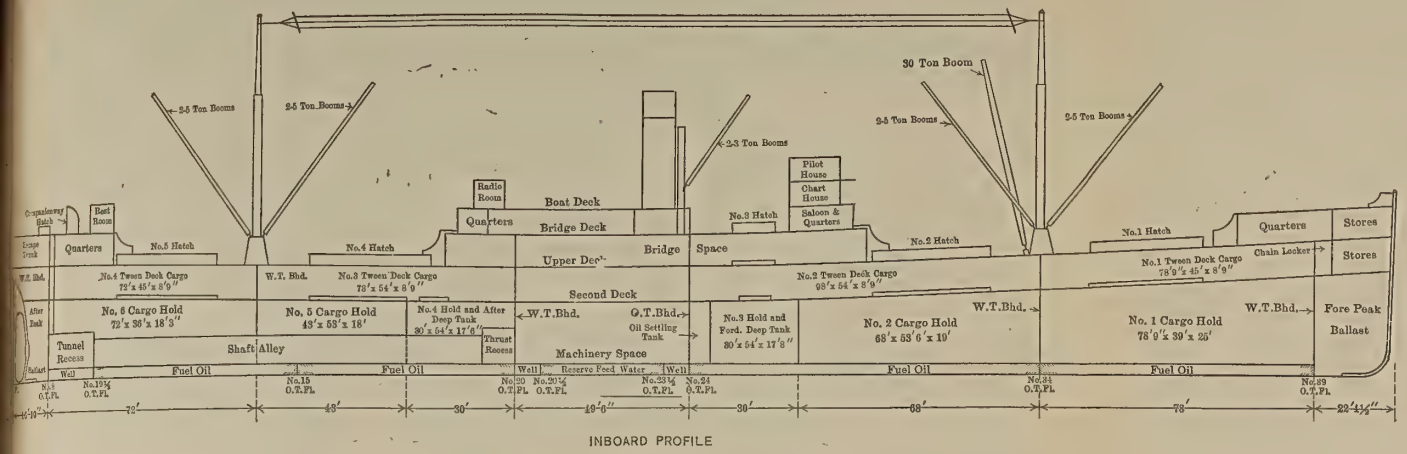


MODERN FWEIGHT

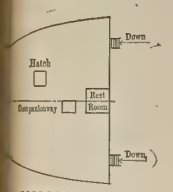


MODERN FREIGHT STEAMSHIP OF 8,800 TONS DEADWEIGHT

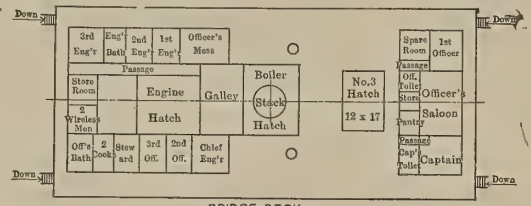
Built by the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.



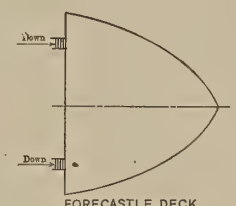
INBOARD PROFILE



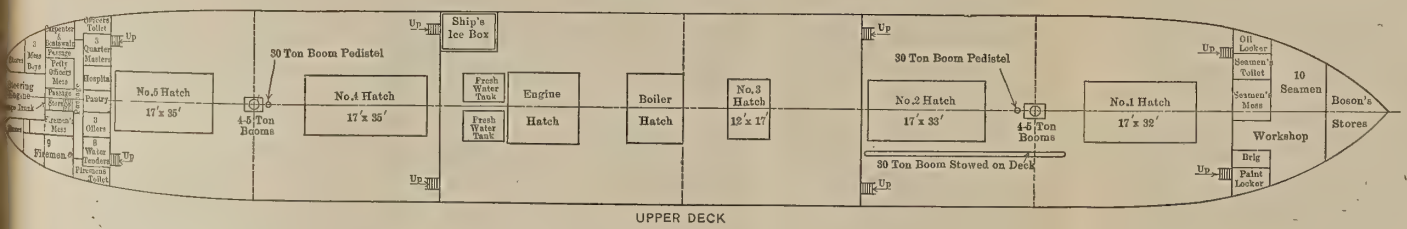
POOP DECK



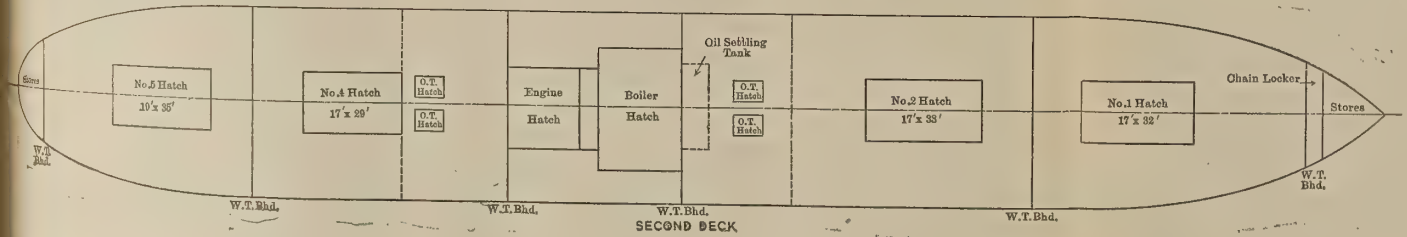
BRIDGE DECK



FORECASTLE DECK



UPPER DECK



SECOND DECK

Fig. 4.—Deadweight Scale and Capacity Plans

TABLE OF CAPACITIES AND GENERAL PARTICULARS.

TANK CAPACITIES

TANK	WATER BALLAST TONS	FUEL OIL TONS	FUEL OIL BARRELS
NO.1 D.B. TANK	—	183	1257
NO.2 D.B. TANK	—	395	2669
NO.3 D.B. FEED WATER TANK	157 F.W.	—	—
NO.4 D.B. TANK	—	241	1657
NO.5 D.B. TANK	—	120	815
FORE PEAK	199 S.W.	—	—
AFTER PEAK	45 S.W.	—	—
FORD. DEEP TANK	736 S.W.	—	—
AFTER DEEP TANK	765 S.W.	—	—
F.O. SETTLING TANK	—	77	529
TOTAL CAPACITY	1902	1091	6918

FRESH WATER TANKS	U. S. GALLONS
MAIN TANK STARBOARD	4400
MAIN TANK PORT	4400
GRAVITY TANK OVER GALLEY	225
GRAVITY TANK OVER RADIO HOUSE	150
GRAVITY TANK IN NO. SIX HOLD	250
TOTAL CAPACITY	9425.

NOTES
SALT WATER TAKEN AT 35 CU. FT. PER TON
FRESH WATER TAKEN AT 36 CU. FT. PER TON
ALL CAPACITIES OF D.B. TANKS GIVEN ABOVE INCLUDE
BOTH PORT AND STARBOARD TANKS
BARRELS ARE OF 42 GALLONS EACH
FUEL OIL TAKEN AT 38 CU.FT. PER TON

SHIP'S ICE BOX	330 CU.FT.

CARGO CAPACITY

COMPARTMENT	CU. FT. GRAIN	CU. FT. BALE
NO. 1 HATCH UPPER DECK	2040	—
NO. 2 HATCH UPPER DECK	2100	—
NO. 3 HATCH UPPER DECK	560	—
NO. 4 HATCH UPPER DECK	2100	—
NO. 5 HATCH UPPER DECK	2100	—
TOTAL HATCHES	8900	—
NO. 1 HOLD	79339	70390
NO. 1 TWEEN DECK	30620	29008
NO. 2 HOLD	65670	59068
NO. 2 TWEEN DECK	42239	40119
NO. 3 HOLD & FORD. DEEP TANK	24986	24206
NO. 3 TWEEN DECK	29820	28310
NO. 4 HOLD & AFTER DEEP TANK	25973	25108
NO. 4 TWEEN DECK	27410	26095
NO. 5 HOLD	20597	19468
NO. 6 HOLD	46369	44650
TOTAL HOLDS & HATCHES	387085	370420
BRIDGE SPACE USED FOR CARGO UPPER DECK	35273	33510
TOTAL CAPACITY	422358	403930

HULL

LENGTH OVERALL	423'5"
LENGTH B.P.	410'5½"
BEAM MOLDED	54'0"
DEPTH MOLDED	30'6"
LOAD DRAFT	24'1"
GROSS TONNAGE	6245.67
NET TONNAGE	4731.00
UNDER DECK TONNAGE	5331.74
PANAMA GROSS TONNAGE	6730.96
PANAMA NET TONNAGE	4695.47
PANAMA UNDER DECK TONNAGE	5693.85
OFFICIAL NUMBER	217515
OFFICIAL LETTERS	L P R Q
RADIO CALL LETTERS	K E V B
SPEED LOADED	10½ KNOTS

MAIN ENGINE

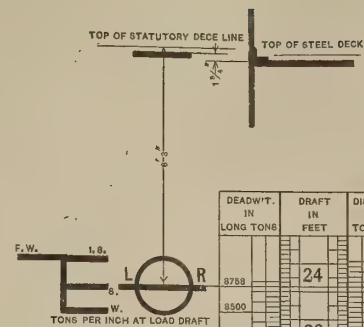
S.H.P.	2500
GENERAL ELECTRIC - FULL EXPANSION	
TYPE DOUBLE REDUCTION GEAR	
GEAR RATIO = 87.5	

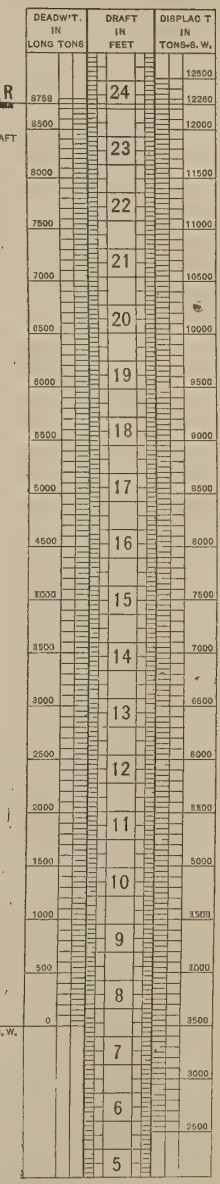
BOILERS

FOUR HEINE WATER TUBE	
W.D. = 200 ☐ T.H.S. = 11,192 ☐	
OIL BURNING, NATURAL DRAFT	
THREE FURNACE, NO DONKEY BOILER	

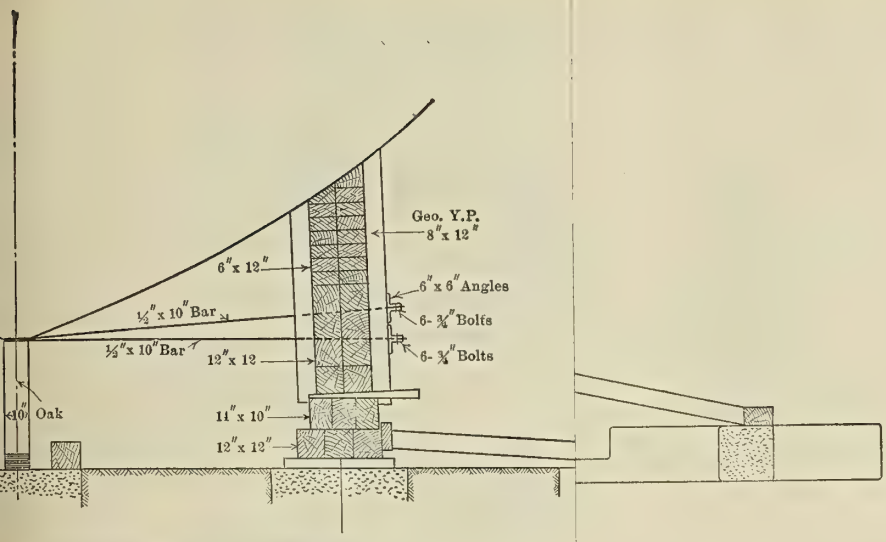
PROPELLER

ONE SOLID CAST IRON FOUR BLADES	
DIA. = 17'3" PITCH = 19'4 7/16"	
P.A. = 80% D.A. = 90% R.P.M. = 90	

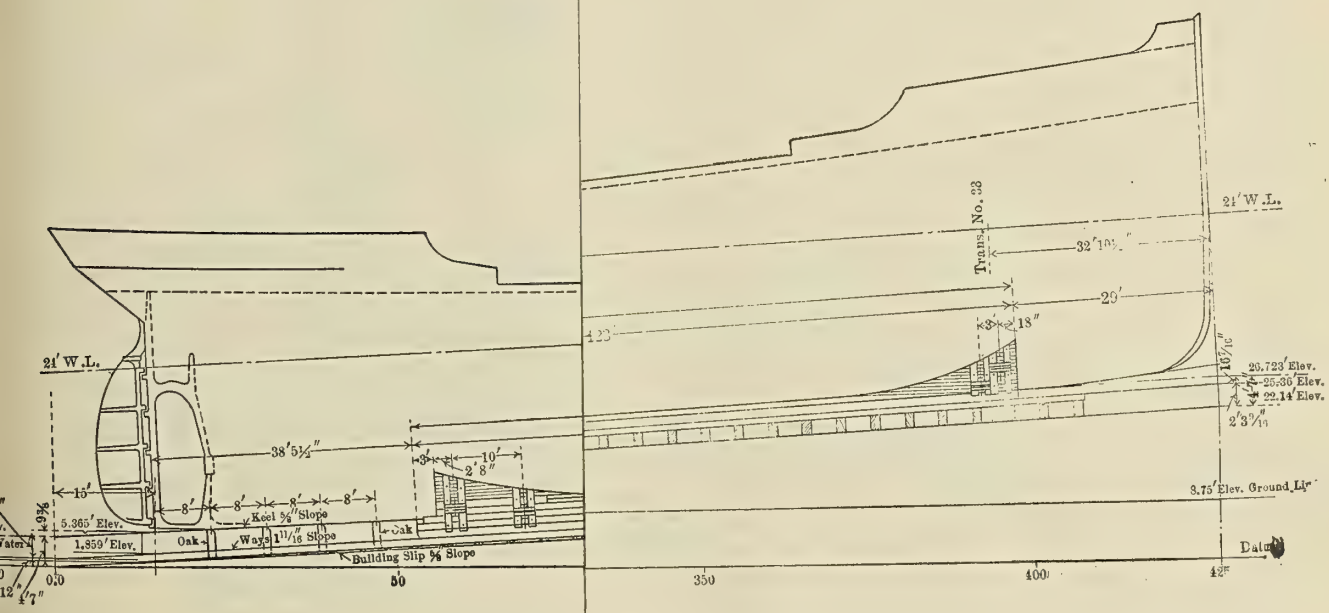




MODERN ADWEIGHT

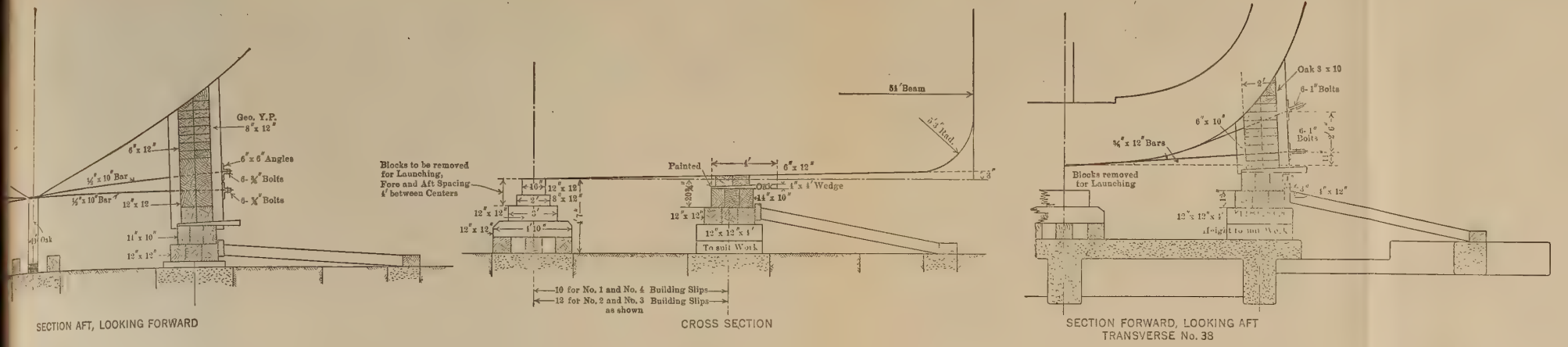


SECTION AFT, LOOKING FORWARD



MODERN STEEL FREIGHT STEAMSHIP OF 8,800 TONS DEADWEIGHT

Built by the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md



SECTION AFT, LOOKING FORWARD

CROSS SECTION

SECTION FORWARD, LOOKING AFT
TRANSVERSE No. 38

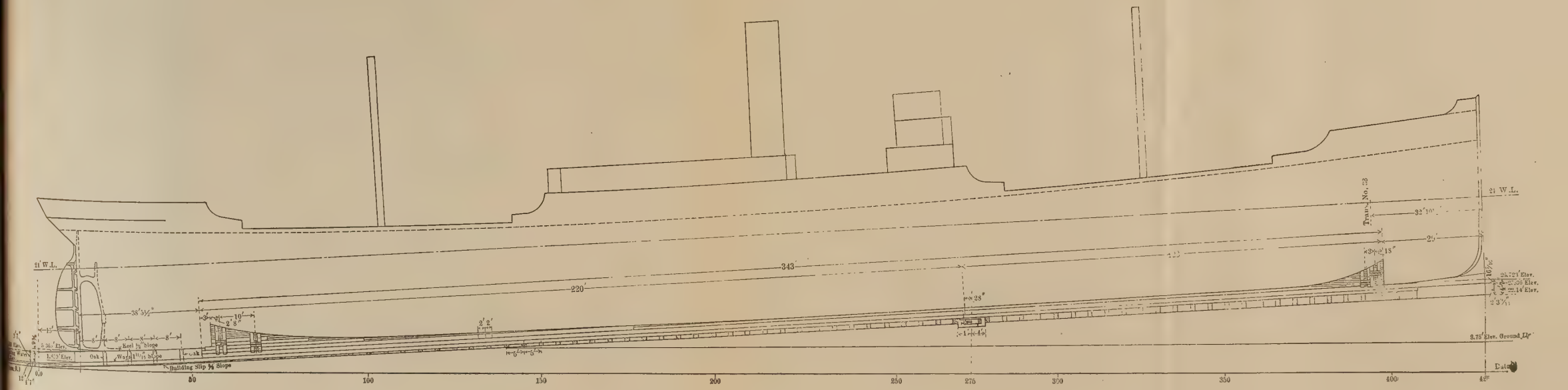


Fig. 5.—Launching Plan

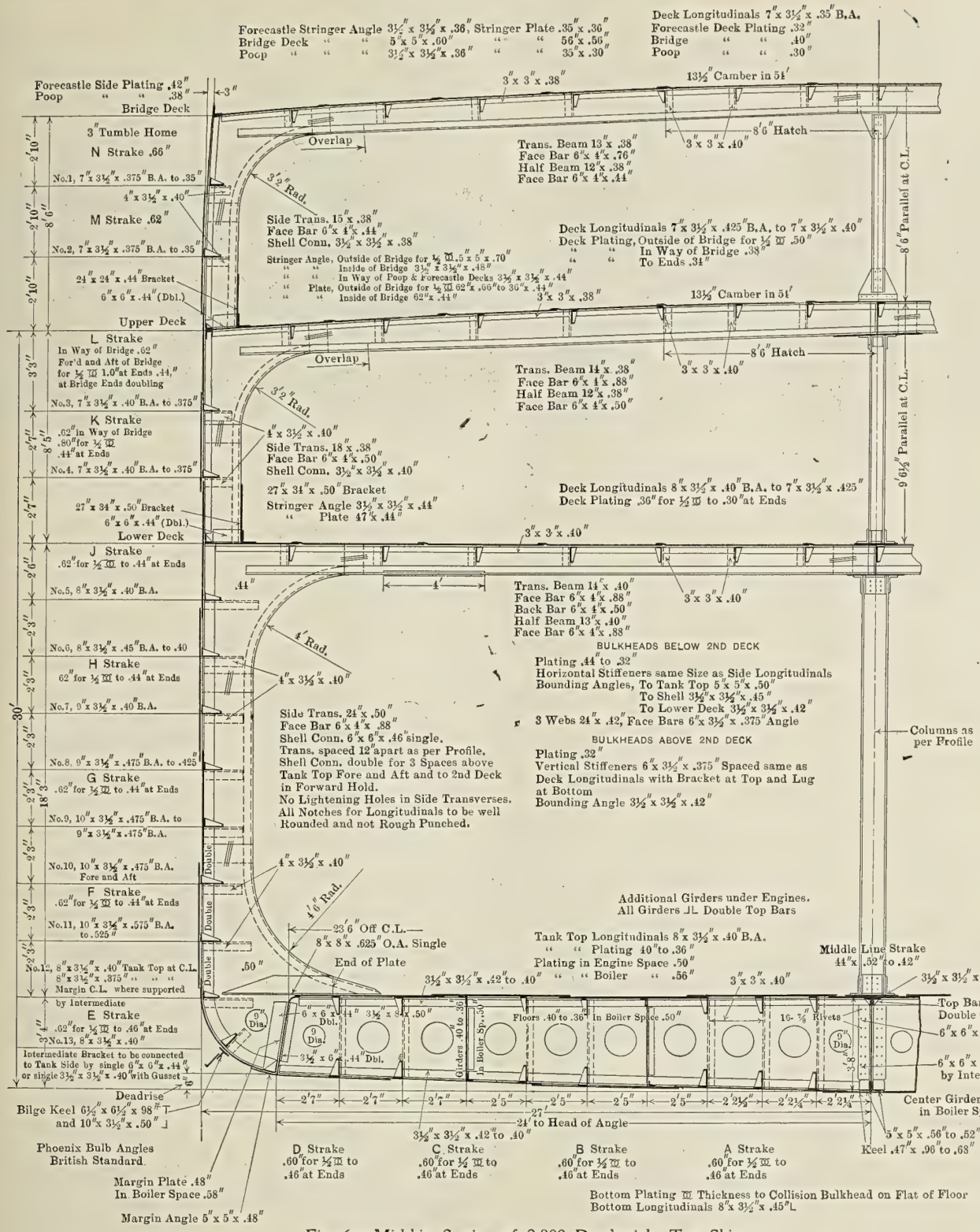


Fig. 6.—Midship Section of 8,800 Deadweight Ton Ship

but this is by no means certain. Given full information, it is possible for the shipbuilder to produce a design at least equal to and probably better than the owner's best previous ship. The final efficiency of a ship depends upon the net income derived from freights in relation to the total cost of the ship.

A ship's earning capacity depends on the amount of deadweight carried and the cubic space for freight in relation to the total displacement. Shipbuilders have usually been content to fulfill the specified conditions of deadweight and speed on as cheap a ship as could be produced, and the owners have often bought the cheapest they could without going fully into the matter of final economical operating cost. The scientific knowledge of the expert in design must be associated with the practical experience of the shipowner before the most suitable design can be decided upon.

The type of cargo-handling machinery and the arrangement of this in relation to the cargo hatches is very important, for the speed with which a ship is loaded and unloaded has much to do with the economical operation of the ship.

The type of propelling machinery and the type of auxiliaries should be considered very carefully, as fuel is

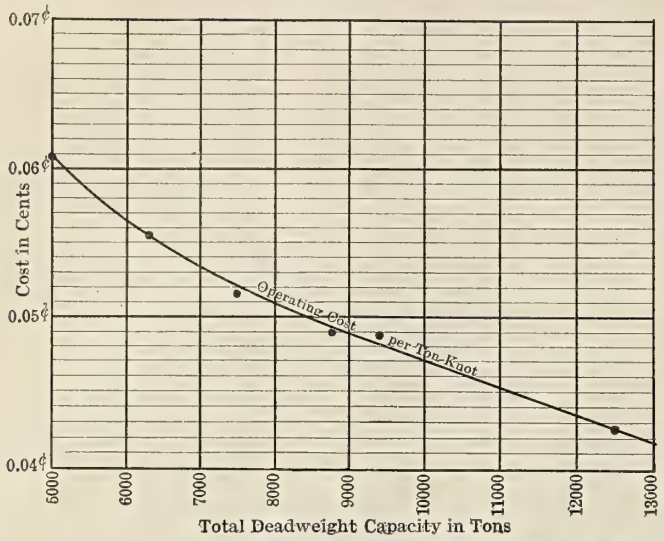


Fig. 7.—Curve Showing Relative Operating Costs of Different Size Ships



Fig. 9.—Vertical Keel in Place

the principal operating cost. For the type of freight ship we have under consideration, the following types of propelling machinery are most desirable:

Steam reciprocating engines; steam turbines with reduction gears; oil engines of the Diesel or semi-Diesel type; boilers of the Scotch or straight large tube type of watertube boilers, using either oil or coal as fuel.

Other things to be considered are: The type and method of driving the engine-room auxiliaries, also winches, steering gear, etc.; the steam pressure to be used and the amount of superheat, if any; type of condensing apparatus; type of draft for boilers, whether natural or forced.

Steam Reciprocating Engines

If reciprocating engines are used, they should have a fairly large ratio of low-pressure to high-pressure cylinder to enable the expansion of steam to be properly carried out.

Cylinder clearance should be reduced to the lowest practical limits. To obtain this, the ports, particularly for the high-pressure and intermediate-pressure cylinders, should be straight and short, using offset valve stems if necessary to shorten the ports. Both sides of pistons, bottom of cylinder covers and cylinder bottoms should be machined so the end clearance can be kept to the minimum, say 3/8-inch top and 1/2-inch bottom for engines from 1,800 to 3,500 indicated horsepower.

The high-pressure and intermediate-pressure valves should be of the piston type, with a double-ported slide valve for the low-pressure up to 3,000 indicated horsepower. Above this power, the low-pressure valve should also be of the piston type in order to keep down the size of the valve gear.

The use of steam jacketing does not appear to be justified, but special attention should be paid to insulating the cylinders and all steam radiating surfaces.

Triple-expansion engines using steam from boilers designed for 200 pounds working pressure and a cylinder ratio giving about twelve expansions should develop an indicated horsepower on about 13½ pounds of water.

Steam Turbines

Steam turbines with reduction gearing as built by several of the large turbine builders will give a shaft horsepower on about 12 pounds of water. The turbine, however, requires more steam for its auxiliaries, and when all of this has been considered the turbine would appear to require about 15 percent less steam than the reciprocating engine. This, of course, means the same saving in fuel.

Reliability in service, repairs, weight and available supply of trained men for operating are points to be considered when deciding on the best type of propelling engines.

There is no doubt but that both types will be used for



Fig. 8.—Flat Keel in Place

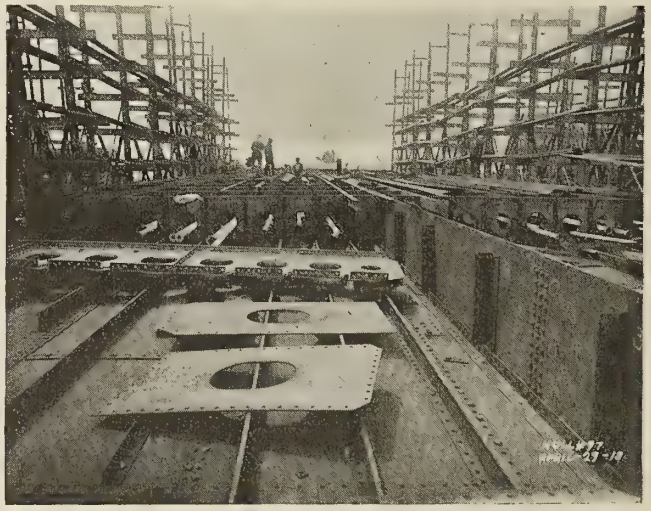


Fig. 10.—Midship Floors and Drainage Piping in Place

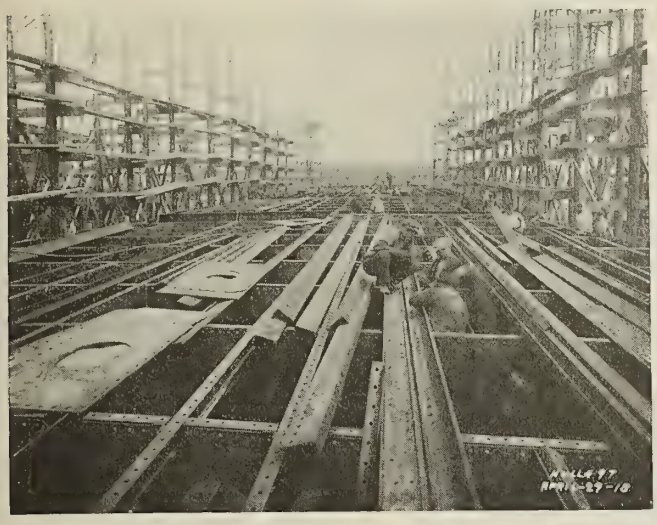


Fig. 11.—Tank Top Longitudinals and Floors in Place

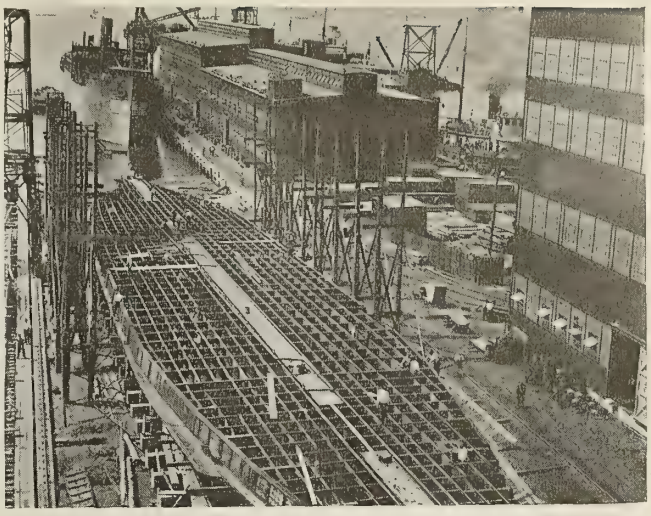


Fig. 13.—Inner Bottom Framing in Place

many years to come. For the smallest ships, with engines of 1,800 horsepower or less, the reciprocating engine would appear to be better on account of its simpler construction and simpler auxiliaries and cheaper grade of engineers employed on this type of ship. Above this power, and particularly above 3,000 horsepower, the preference would appear to be for the turbo reduction gears. On ships requiring this size engine, the engineering forces are better paid, and consequently better men are obtained to operate this more refined type of machinery.

The turbine is much more adaptable to the use of superheat and high vacuum, and these two items have a large bearing on the question of economy. A few years ago it was difficult to obtain over 27½ inches of vacuum, but today 29 inches is about as easily obtained by the use of steam air ejectors working in conjunction with a condensate pump.

With reduction gears, the lubricating system is of utmost importance, as the success of the gears is dependent upon the efficient operation of the lubricating system. With an efficient lubricating system there will be practically no overhauling or repairing required with the reduction gear sets.

Boilers

In considering boilers for steam installations, the first question is the kind of fuel. If oil is to be used, and the horsepower is above 2,500 and turbo reduction gears and superheat are to be used, the watertube boiler would appear to have the advantage on account of the cheaper first cost and the lighter weight and less space required.

With the oil-burning installation there is little dirt and

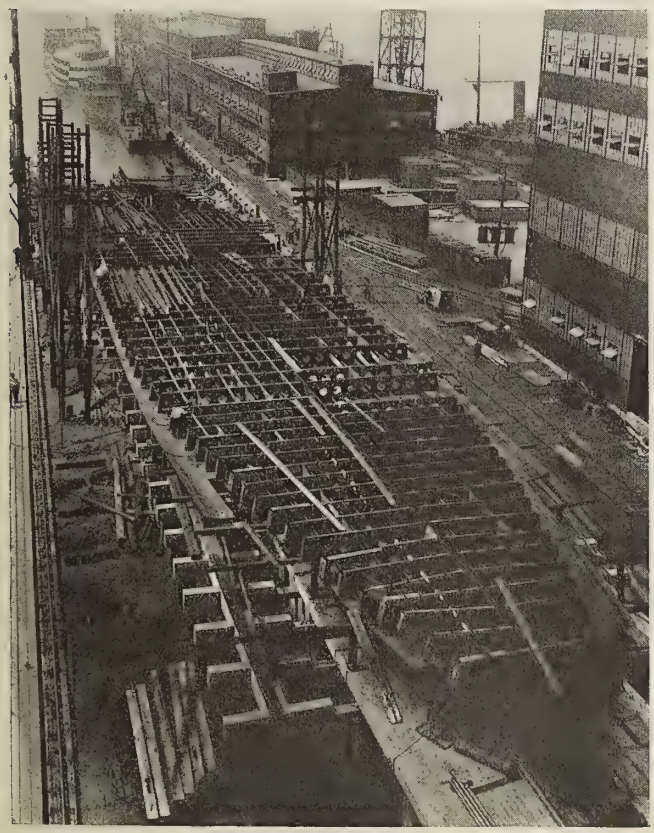


Fig. 12.—View Showing All Floors in Place

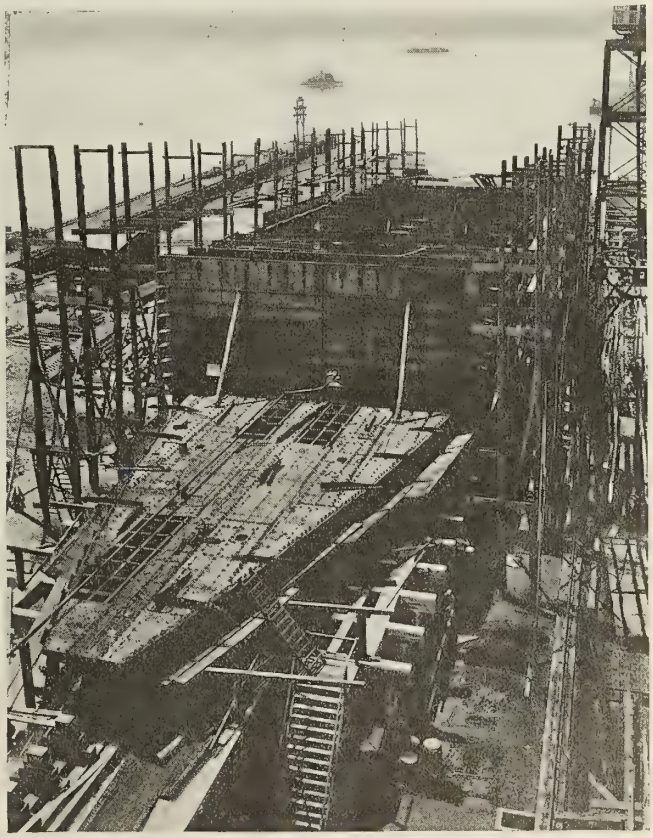


Fig. 14.—Midship Bulkheads and Transverses in Place

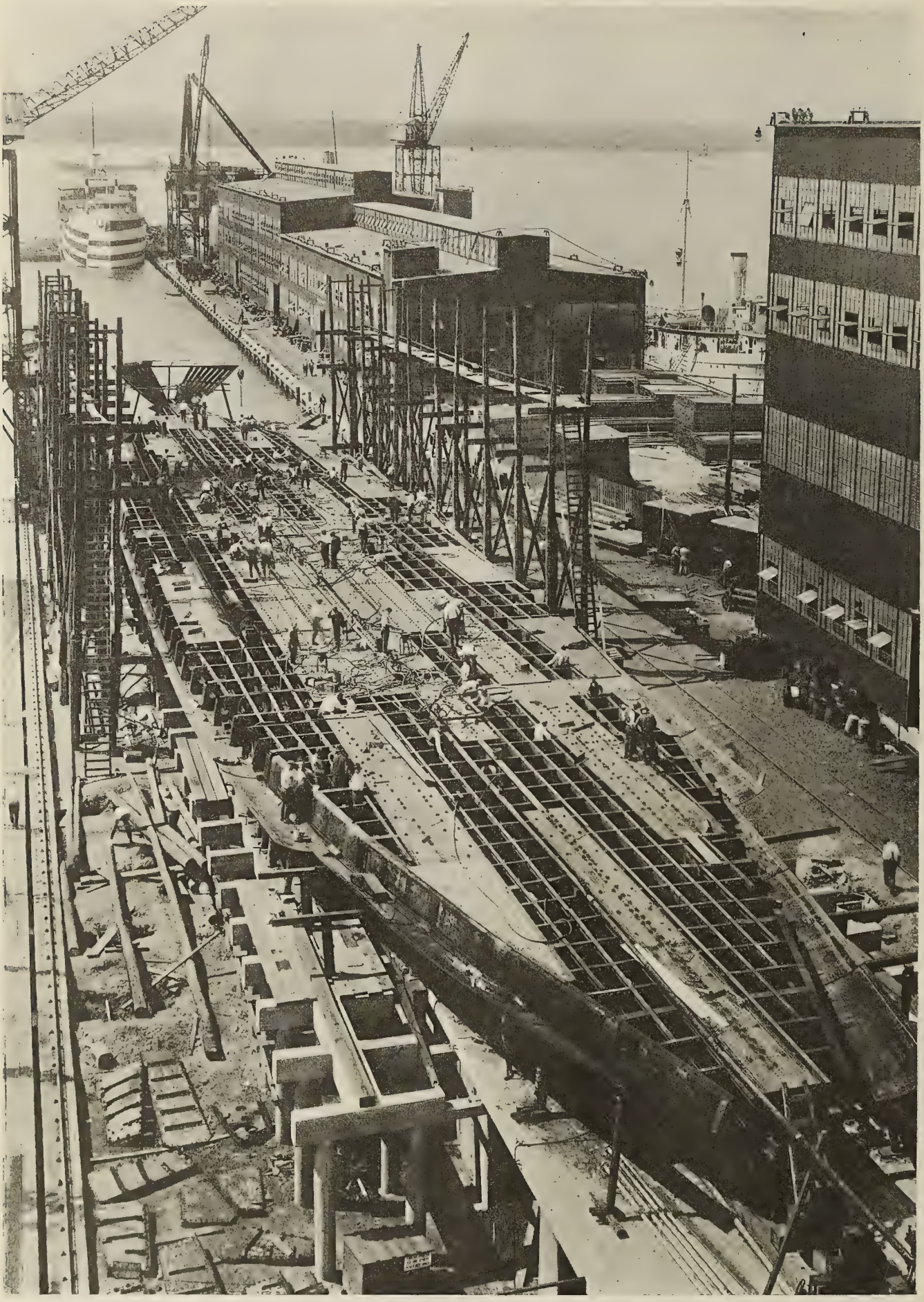


Fig. 15.—View Looking Aft, Showing Aft Peak Transverses and Tank Top Being Put in Place

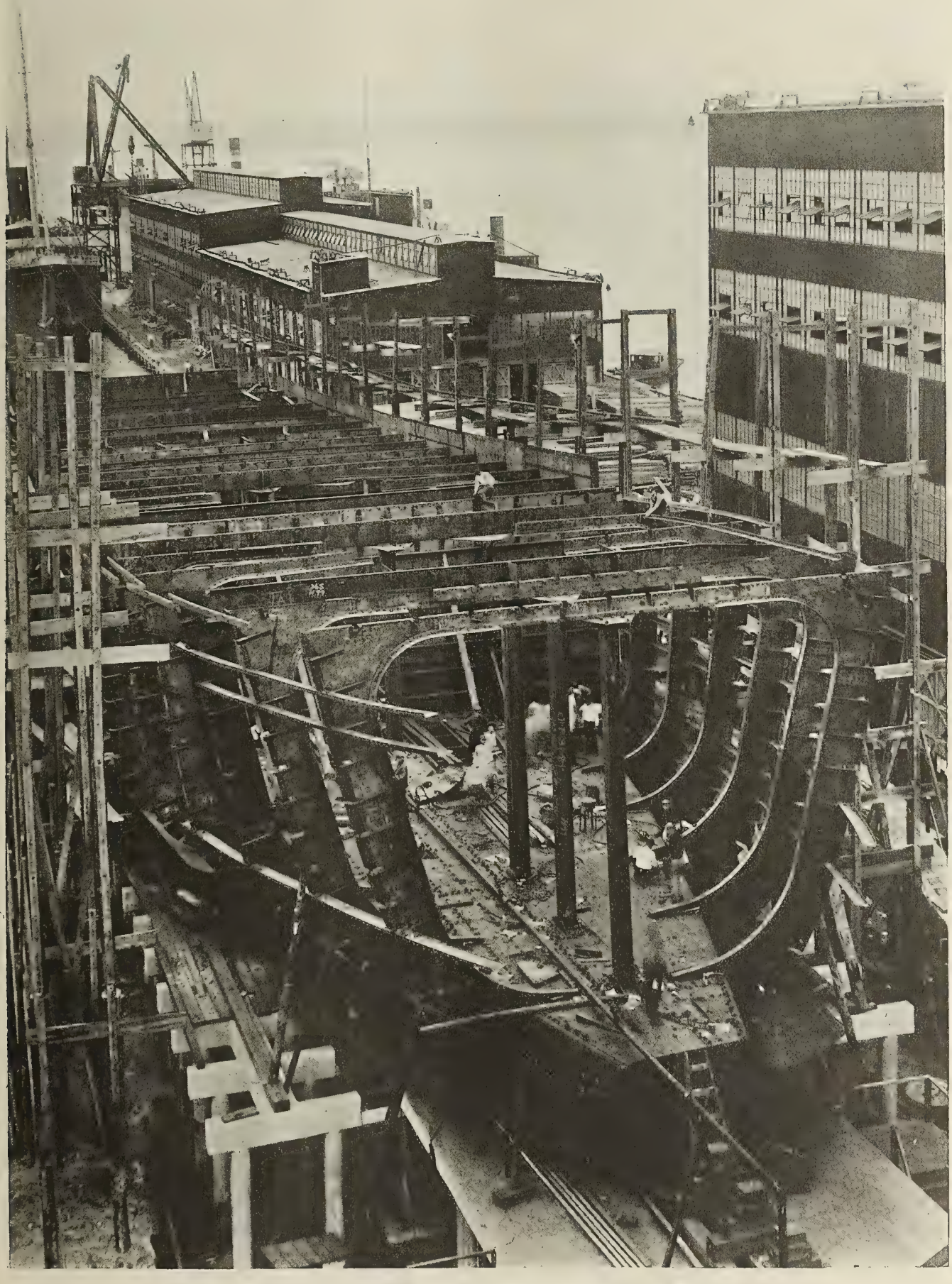


Fig. 16.—View Looking Aft, Showing Forward Transverses in Place

no ashes, and for this reason oil-burning watertube boilers are not subjected to the same deterioration as the coal-burning watertube boiler.

For coal burning with forced draft and reciprocating engines the Scotch type would appear to have the advantage because the deterioration of the brick work in the watertube boiler would be done away with, and also the larger steam space required for the reciprocating engine would be obtained with the Scotch boiler.

Superheat should be used on both types of boilers, except in low-powered installations. For the reciprocating installation a total temperature of 450 degrees F., and for the turbine 500 degrees F., would appear to give satisfactory results. Higher temperatures than these would require special material for piping, valves and fittings and present difficulty in effecting repairs in foreign ports. Ordinary steel and good bronze will take care of 500 degrees F. without trouble.

The advantage to be gained in economical operation by use of superheat has been neglected in the past, but is now generally recognized, as an almost universal use of superheat may be looked for in the future.

Diesel or Other Oil Engines

The particular field for Diesel or other oil engines is for small- or medium-powered ships designed to operate on long voyages and to places where coal for fuel would be hard to obtain. For horsepowers from 1,500 to 2,500, very reliable and economical installations can be obtained. The oil-engine installations will require about one-half the fuel that the best steam installations do. Less attendants will be required and the weight will be slightly less.

For the above power a four-cycle engine is recommended because it is simpler and less liable to cause trouble in getting rid of the heat. With an installation of this kind, a donkey boiler should be supplied capable of being operated by the engine exhaust gases at sea and by oil fuel in port. The boiler should be large enough to operate the steering engine, the sanitary and bilge pumps, and furnish steam for heating and cooking. A small Diesel engine-driven electric generator should be installed for supplying the current to the electric cargo winches for port use.

The Diesel engine will have special advantages when trading in Gulf ports or on the Pacific coast, or similar places where oil is more readily obtainable than coal. While the Diesel-engined ship requires a smaller engine room force, it also requires a more intelligent and higher paid force; therefore there would be but little advantage for the Diesel engine in saving wages in the engine room force.

The principal objection to Diesel engines in the past has been their unreliability in operation and the excessive repair bills, particularly with the two-cycle engines.

Comparison of Types of Motive Power

In summing up, it will be noted that the largest items of operating expense are fuel and the pay of the engine room force. Hence, successful designers of machinery will have as their chief aim the securing of economy in operation and the reduction of the operating force. The first cost has too often been the deciding factor. The saving in operating expense of a few years will make up the increased first cost of a more economical design. Where a number of ships are being built from one design, the importance of perfection in the design is greatly increased, for a defect or advantage are both multiplied many times.

The comparison from the operator's point of view is often based on cost per ton-knot. Basing this ton-knot cost on interest, depreciation, etc., of the first cost of the ship, and in the cost of crew's wages, food, cost of fuel, oil and other consumable stores, we can show that the cost per ton-knot of a 12,000 deadweight ton ship of 12 knots is about 30 percent less than the cost per ton-knot of a 5,000-ton deadweight ship of 9½ knots. This is clearly shown in the curve shown in Fig. 7.

This comparison, of course, might be extended to much larger ships, but the size of general cargo freight ships is limited on account of other conditions, such as port facilities and the depth of water at different points. The two sizes given above practically cover the extremes in sizes of steel ships which have been ordered by the Emergency Fleet Corporation in their plan to overcome the destruction of shipping by the German submarines.

In looking over a list recently published giving average size of English freight ships, we find the averages for five of the largest operators are:

Operator	Number of Ships	Gross Tons	Average Size
Furness Line	155	699,001	4,510
Ellerman Lines, Ltd.	108	607,870	5,628
British India	125	588,878	4,711
Alfred Holt & Company	74	509,744	6,888
Peninsular & Oriental Company	47	409,086	8,704

To compete with these ships it seems desirable for the future, except for special trade, that we construct no ship of less than 8,800 deadweight tons capacity. This would equal about 6,200 gross tons and would be larger than the average of the ships just mentioned.

The ship which will be used as an example is an 8,800 deadweight ton, 10½-knot ship, eight of which are being built for the Emergency Fleet Corporation by The Baltimore Dry Docks & Ship Building Company, Baltimore, Md. The ship has a light displacement of 3,433 tons; the load displacement is 12,260 tons, making the deadweight capacity 8,827 tons. This is shown in the deadweight scale and capacity plan, Fig. 4.

The register tonnages of the ship are as follows:

American	gross tonnage	6,240.66
"	net tonnage	4,704.00
"	under deck tonnage	5,331.74
Panama	gross tonnage	6,727.18
"	net tonnage	4,843.09
"	under deck tonnage	5,699.85

General Description of the 8,800 Deadweight Ton Ship

Length overall	423 feet 9 inches
Length between perpendiculars	10 feet 5½ inches
Beam, molded	54 feet 0 inch
Depth, molded	30 feet 0 inch
Draft, designed load	24 feet 1 inch
Cubic capacity for grain	422,358 cubic feet
Deadweight (24 feet 1 inch draft)	8,827 tons
Fuel oil capacity	1,019 tons
Fresh water (boiler feed)	157 tons
Fresh water (drinking)	8,800 gallons
Speed, loaded	10½ knots
Shaft horsepower	2,500
Revolutions per minute	90

The vessel will be a steel single-screw cargo steamer of the poop, bridge and forecastle type, complete double bottom, built on the longitudinal system of construction. Machinery will be amidships. Oil will be carried in Nos. 1, 2 and 4 and 5 inner bottom tanks and in deep settling tank at forward end of machinery space. Boiler feed water will be carried in No. 3 inner bottom tanks under machinery space. There will be two masts with four 5-ton booms on each and two derrick posts each with one 3-ton boom.

The forward and after holds will each be divided into

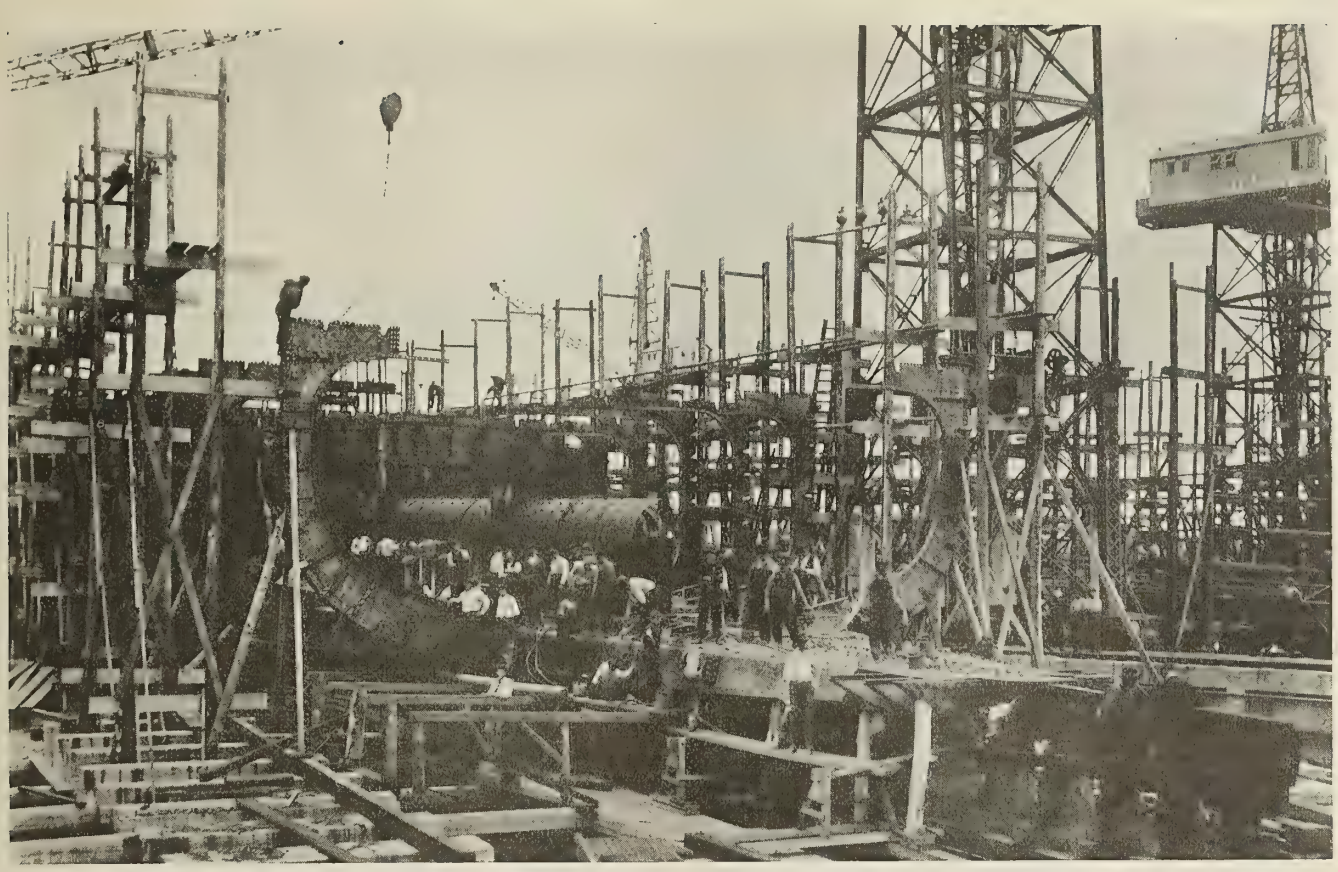


Fig. 17.—View Looking Forward, Showing Aft Transverses and Shaft Alley Being Put in Place



Fig. 18.—View Looking Forward, Showing Aft Peak Bulkhead and Side Longitudinals in Place

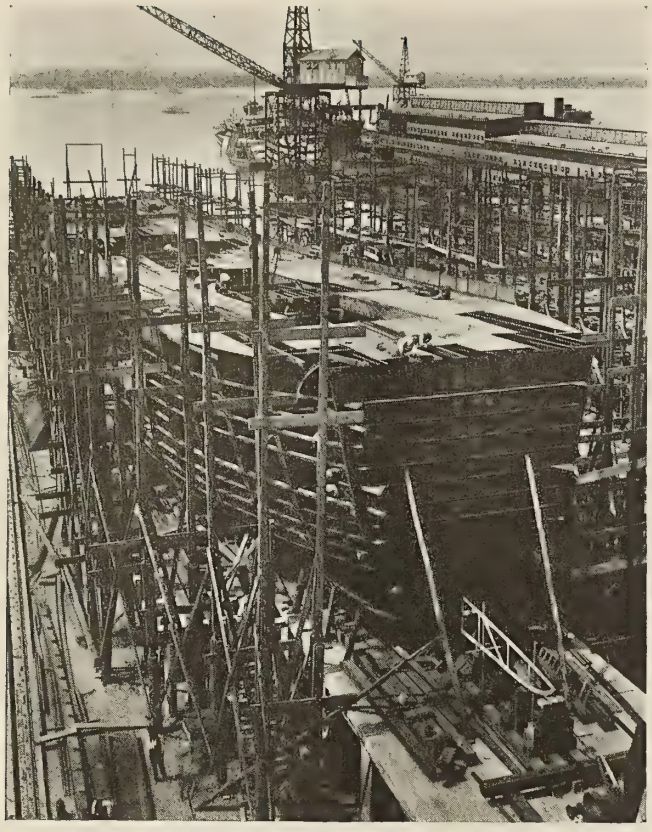


Fig. 19.—Fore Peak Bulkhead, Transverse Framing and Upper Deck in Place

two compartments by transverse watertight bulkheads. There will be four large and one small cargo hatches through the upper and second decks. Wide-spaced hold and 'tween deck pillars will be fitted, arranged so as not to interfere with the rapid stowage and discharge of cargo.

The general arrangement is shown in Fig. 3, profile and deck plans.

The propelling machinery will consist of one Curtis five-stage ahead turbine of 2,500 shaft horsepower and a two-stage backing turbine in the same casing, which will give about 60 percent of the ahead power. The turbine will be connected to the propeller shaft by a two-stage reduction gear. The turbine will exhaust into a surface condenser of 4,000 square feet cooling surface. To the condenser will be connected a 16-inch turbine-driven centrifugal circulating pump, a 3-inch turbine-driven condensate pump and two E-2 Radojet air pumps, the condensing outfit to be capable of maintaining a vacuum of 28½ inches when the main turbine is operating at full power. There will be four watertube boilers of the Heine type, having a total heating surface of 18,000 square feet and fitted for burning oil under natural draft.

The following auxiliaries will be furnished and connected in the usual manner for a vessel of this type:

One R. & L. screw steering engine with double 8-inch by 7-inch cylinders.
One double spur-geared anchor windlass with double 9-inch by 9-inch cylinders.
One capstan, double 6-inch by 8-inch cylinders.
Four winches, double 9-inch by 9-inch cylinders.
Six winches, 8¼-inch by 8-inch cylinders.
One auxiliary condenser of 950 square feet cooling surface, with attached combined air and circulating pump.
Two 10-kilowatt electric generating sets.
One 25-ton evaporator.
One feed water heater.
One 12-inch by 8-inch by 18-inch simplex main feed pump.
One 12-inch by 8-inch by 18-inch simplex auxiliary feed pump.
One 12-inch by 8½-inch by 12-inch duplex fire and donkey pump.
One 10-inch by 12-inch by 12-inch duplex ballast pump.
One 7½-inch by 6-inch by 10-inch duplex bilge pump.
One 6-inch by 6-inch by 6-inch duplex sanitary pump.
One 6-inch by 4-inch by 6-inch duplex fresh water pump.
One 5¾-inch by 3½-inch by 5-inch duplex evaporator feed pump.
Two 7½-inch by 7-inch by 10-inch duplex lubricating oil pumps.
One 7½-inch by 7-inch by 10-inch duplex oil cooler pump.
One 7½-inch by 6-inch by 10-inch duplex fuel oil transfer pump.
Two 5¼-inch by 3½-inch by 5-inch duplex fuel oil pumps.

Fig. 5 shows the launching plan, and the following data were taken at the time of launching:

Declivity of keel	⅝ inch per foot
Mean declivity of ways	11.2/16 inch per foot
Water over end ways	7 feet 3½ inches
Vessel ran her length from start	31 seconds
Mean velocity	13.25 feet per second
Length of sliding ways	343 feet
Width of sliding ways	2 feet 6 inches
Effective area of sliding ways	1,715 square feet
Draft forward	5 feet 2 inches
Draft aft	8 feet 6 inches
Mean draft	6 feet 10 inches
Density of water	35.602 cubic feet per ton
Launching displacement	3,010 tons
Mean weight per square foot on ways	1.75 tons
Pivoting pressure on fore poppets	850 tons

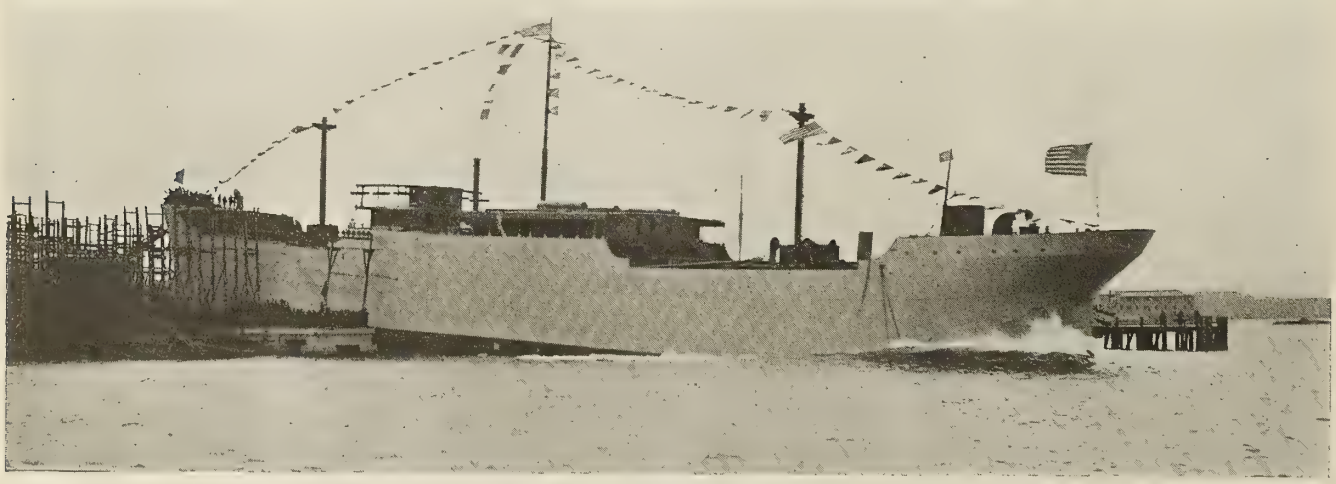


Fig. 20.—Launching, Stern View

Congress and the Merchant Marine

Shipping Measures Before the Senate and House of Representatives—Little Headway Being Made Towards Shipping Policy

BY WALDON FAWCETT

WITH the committee on commerce of the United States Senate marking time during the dog days on the general proposition of the formulation of a policy in encouragement of the American merchant marine, the House of Representatives has established contact with the general subject via its committee on the merchant marine and fisheries. There is, however, a difference in procedure in the two branches of Congress that is interesting, if not significant. As has been explained in the August issue of MARINE ENGINEERING, the programme in the United States Senate calls for a general canvass of the shipping situation by the committee on commerce with the object of formulating and recommending to the Senate for approval comprehensive legislation designed to deal with such aspects of the subject as may seem to require Federal sanction or support.

In the House of Representatives, on the other hand, there has been disclosed during the past month a plan of procedure that is directly the opposite of that in the Senate. Instead of pondering the broad proposition and leaving individual bills to wait upon the determination of a national policy, the disposition in the House of Representatives' committee on the merchant marine is to consider, as a prospective law unto itself, each proposal that is put before it. Nor is there any lack of original, not to say unique, ideas on this subject, as is eloquently attested by the range of discussion in public hearings conducted by the House committee during the past few weeks.

> "Every element that goes to make up what is called American shipping should be governed and controlled by Americans; otherwise it is not American shipping. There is no reason in the world why American shipowners should have their ships classed, insured or anything else abroad. You cannot expect the people abroad to lie awake nights to help American shipping as against their own shipping. Therefore all elements—the underwriters, the shipowners, the shipbuilders and the ship operators—should look to American institutions for those things they need. That is fundamental—American interests are best served in American institutions."—COMMODORE E. P. BERTHOLF, U. S. C. G. (Retired).

SHIPPING MEASURES BEFORE CONGRESS OF DIVERSE CHARACTER

Without attempting to catalogue all the proposals with respect to shipbuilding and the merchant marine that have been placed before the merchant marine committee for scrutiny, it may be permissable to cite a few examples as indicative of the diversity of the suggestions advanced. For example, Congressman Greene of Massachusetts has introduced a bill (H. R. 5498) which lays down a complete formula for the sale, charter and operation of the merchant ships owned by the United States. Set over against that is the panacea of Congressman Walsh, who, in the bill designated officially as H. R. 4417, seeks the creation within the Government of an executive department to be known as the Department of Marine and Fisheries, to which would be transferred the United States Shipping Board, which would function as one cog in the new machine under the name "Bureau of Merchant Marine." Looking in yet another direction we find awaiting the attention of this committee on eligibility the bill of Representative Alexander (H. R. 3621) to establish load lines for vessels; and so the list of candidates might be considered almost indefinitely.

One of the first proposals to have consideration at the hands of members of the House committee on merchant marine was the bill making it unnecessary to secure permits from the United States Shipping Board for the construction of ships in American shipyards for foreign account. Various officials of the Shipping Board appeared before the committee to shed light on the attitude of the Governmental body, and there was some representation of the shipbuilders who favor freedom of action in the premises—notably by Harrison S. Robinson, who appeared as spokesman for the steel shipbuilding interests of California, Oregon and Washington.

After it had been pointed out that legislation of this class was really unnecessary in the face of President Wilson's advices giving the Shipping Board permission to authorize American shipbuilders to build for foreign account, the present attitude of the Shipping Board was revealed as one wherein no obstacle would be placed in the way of the negotiation of foreign contracts, but that there is a wish that shipbuilders who are in a position to undertake the construction of 10,000-ton ships would give preference to American contracts over foreign orders at an even price. The position of the Shipping Board was concretely stated as follows: "We might be handicapped if our yards filled up with foreign orders as a result of shipbuilders not coming to us before executing contracts. If the shipbuilders are building small-size ships, we would not be interested at all. But with the large size ships we desire to build ourselves, we do not want our yards filled up with foreign orders—that is, the particularly efficient yards for these large ships—with the result that we must wait until such time as the foreign orders were finished."

GRADUAL REDUCTION IN PRICES SOUGHT

There was, in this connection, reiteration of the intention of the Shipping Board to build something over 125 ships of 10,000 tons and upward. A tabulation showed 74 vessels of this class now under construction, and hasty estimates during the hearings gave a total of not to exceed 15 shipyards out of the 67 equipped to build ships of this size. The available ways for this class of hulls were figured as between forty and sixty. Apropos a discussion of the cost of the new construction, it was stated that in the case of yards where Government contracts for vessels of smaller size have been suspended, and an effort

has been made to arrange replacement contracts at a flat price, it is the hope of the Shipping Board executives "to get down to a flat price of $160 or $165 (33/6/8 or 34/7/6) a ton."

The attitude of the Shipping Board, as reflected in lengthy discussions by its officials before the Congressional committee, was one of desiring to see the price of new tonnage come down, but come down gradually instead of precipitately to the demoralization of the industry. Fear was expressed that unless some steadying and stabilizing influence be kept at work there might be a temptation on the part of some shipbuilders to, for the sake of keeping their plants in operation, accept contracts for foreign account at lower figures than would be justified by actual costs. The point was stressed that, for the sake of the permanent welfare of efficient American shipbuilders who know their cost of production, the Government desires that no foreigners shall get ships from American yards at a lower price than American owners pay and is solicitous that Yankee shipbuilders, in their eagnerness to fill their yards, shall not figure too closely and in consequence name a tonnage quotation that would be heralded all over the world as "the American market price," and which would have to be met by all shipbuilding interests in quest of foreign commissions to build ships.

Shipping Measures Before Congress

SENATE BILLS

S. 153	Jones, Wash., May 20.—Providing for sale or charter and operation of vessels owned by the United States.
S. 633	Jones, Wash., May 23.—Extending provisions of the regulation of steam vessels to vessels owned and operated by the Shipping Board.
S. J. Res. 26	Ransdell, La., May 23.—To return Coast Guard to Treasury Department.
S. 556	Sheppard, Tex., May 23.—To provide for the establishment of free zones in American ports of entry.
S. 575	Fletcher, Fla., May 23.—To establish loadlines for certain vessels.
S. 1652	Walsh, Mass., June 11.—To establish free zone in port of Boston, Mass.
S. 1651	Jones, Wash., June 11.—To construct Pacific cable.
S. 2233	Jones, Wash., June 23.—Authorizing and providing for various aids to navigation and other improvements under Lighthouse Service.
S. 2253	Jones, Wash., June 23.—To authorize suits against the United States in admiralty, etc.
S. 2288	Jones, Wash., June 23.—To provide for establishment of free zones in American ports of entry.
S. 2523	Calder, N. Y., July 17.—Providing for licensing of radio apparatus and operators, etc.
S. Res. 92	Fletcher, Fla., June 24.—Prohibiting sale of United States vessels to foreigners, except when useless to this country; prohibiting sale of any desirable vessels at this time.

Repair Facilities Encouraged

In the course of the hearings before the merchant marine body of the House there was some discussion of the policy of the Shipping Board with respect to the provision of dry docks and facilities for repairs. In behalf of the Board it was stated that this Federal agency is expending about $25,000,000 (£5,130,000) in the construction of ten large dry docks, and was at the same time extending every possible encouragement to private interests to provide installations to the same end. There was instanced the case of a New York corporation that has been in negotiation with the Shipping Board in contemplation of an investment of $8,000,000 to $10,000,000 (£1,640,000 to £2,050,000) in a dry dock plant, and Mr. Hurley, in the course of his remarks, said that the Board hoped to see an expenditure of not less than $50,000,000 (£10,250,000) in the aggregate by private parties for the provision of dry dock and repair facilities. "We are trying to get out of the repair business and get private parties into it," he commented.

While the committees of the Senate and House of Representatives have manifested a certain impatience over the desire of the Shipping Board to retain the power of censorship with respect to private contracts that private shipbuilders may desire to enter into, there has been in these committees little spirit of criticism of the Shipping Board's policy in selling off tonnage. In the main body of the Senate and House, however, there are a number of insurgents who are beginning to be heard from on this score. For example, early in August, Senator Fletcher, former chairman of the Senate committee on commerce, led an attack upon the whole policy of the sale of the Shipping Board's tonnage for foreign interests at private sale. The element in Congress whose view is voiced by Senator Fletcher is opposed to the sale of any Government-owned tonnage whatever, and is especially insistent that if such transfer is to be made it should not be as the result of private negotiations, but only as the outcome of competitive bidding. The argument of these critics of the Shipping Board policy is that transactions such as the reported sale of one hundred steel ships of the Great Lakes type to French and Italian interests operates to build up foreign merchant marines, thereby sharpening the competition to be faced by the new American merchant marine.

Shipping Board Defends Its Sale of Shipping

The defense of the Shipping Board, as set forth in the various Congressional quarters where there has been opportunity to reply to criticism, is that the tonnage sales on the part of the Board are wholly in an effort to modernize and "balance" the American mercantile fleet and to secure an appropriate number of ships suitable to commerce on the trade routes to which the United States must presumably in future devote special attention. Chairman Hurley, shortly before his retirement as chairman of the Shipping Board, stated that the Board desired to sell 1,000,000 tons to foreigners, but he denied that the Board had, as reported, adopted a permanent policy calling for the elimination from its fleet of all vessels under 7,500 tons. One of Mr. Hurley's final expressions of policy on this aspect of the situation was as follows: "We have about a million tons of small coal-burning Great Lakes ships which we are anxious to sell, and we want to take that money and build a larger type of ship, in order that our fleet will be proportionately balanced. Our whole thought is to balance our fleet so that we can compete with other nations in the trade routes throughout the world. It was with that thought in mind that the committee on appropriations authorized us to sell fifty or seventy-five million dollars' worth of old-style ships to foreign governments."

Advocates in Congress of conservation of the war-time accumulation of American merchant tonnage have expressed dissatisfaction over the sale of a few vessels of

tonnage between 7,500 and 9,500, but the Shipping Board has countered with the explanation that only a very few of these vessels have been allowed to go, and only to Americans rather than to foreign account. The general policy has been stated to be to hold on to the larger type of ships and the oil-burning ships. The rule of payment for all such transfers of tonnage has called for 25 percent cash, 7½ percent of the purchase price in six months, and another installment of 7½ percent at the expiration of the next six months, so that 40 percent of the purchase price is paid by the close of the first year. Payment of the balance of 60 percent is distributed over a period of five years.

Marine Insurance Investigated

While the main committee on merchant marine of the House of Representatives has been busy with considerations of shipbuilding and ship ownership incident to the present and prospective operations of the Shipping Board, a sub-committee, of which Congressman Lehlbach of New Jersey is chairman, has taken up the subject of marine insurance in an effort to formulate legislation providing for the insurance of the American merchant marine as it exists and as it will exist in the future. The sub-committee has, during the past month, called into conference a number of specialists on this subject. The opinion has been freely expressed that from the standpoint of the future of American shipping the legislation to be enacted with reference to marine insurance will be the most important that Congress will pass. Accordingly, the Shipping Board's specialists on marine insurance and a committee representing the marine insurance underwriters have given freely of their counsel.

A memorandum prepared for the Congressional sub-committee by B. K. Ogden, acting director of insurance, gives, for the first time, interesting information with respect to the Division of Insurance of the United States Shipping Board Emergency Fleet Corporation. It is shown that in January, 1918, the Shipping Board appropriated the sum of $10,000,000 (£2,050,000) to serve as a working capital for its insurance fund; but about one year later this appropriation was withdrawn, it not having been found necessary to use the funds and sufficient reserve having accumulated. An advisory insurance committee, which was in charge, administered this fund in the same general way that marine insurance companies conduct their business. Each steamer was entered in the fund at an appropriate valuation and at rates in accordance with the anticipated service. At first only war risks on requisitioned tonnage were handled, but when, last year, the steamers constructed by the Emergency Fleet Corporation began to operate, the fund assumed both marine and war risks on them from the date of delivery by the builders.

With the idea of not showing a profit, but of giving the Shipping Board adequate and sound protection at the lowest cost, the marine rates used in the insurance fund were based on market quotations less about 25 or 30 percent, this deduction being warranted by the saving in overhead. The annual marine rate for steel steamers was originally 3¾ percent, but, owing to heavy losses, the rate was increased in the autumn of 1918 to 4¼ percent, the insured values of steamers when less than ten years old being increased at the same time from $175 to $200 (36/9/2 to 41/13/4) per deadweight ton. For wooden and composite steamers the annual rate was originally fixed at 6¼ percent, and this was later increased to 7¼ percent. In February, 1919, the rate for steel steamers was reduced to 3½ percent, but the rate for wooden and composite steamers was raised to 7½, the insured values of both classes of vessels remaining as before, namely, $200 (41/13/4) per deadweight ton for steel, and $150 (31/5/0) per deadweight ton for wooden and composite. The rates for war-risk insurance ranged downward from 5 percent in 1917 to ⅛ of 1 percent following the signing of the armistice.

The Shipping Board officials have recommended to the Congressional committee that the Government continue to carry its insurance and distribute claims over the entire fleet until such time as the Government disposes of the ships to private owners—pre-

Shipping Measures Before Congress

House Bills

H. R. 7500	Scott, Mich., July 17.—To repeal law permitting foreign vessels to engage in coastwise trade during war. Report by Merchant Marine and Fisheries Committee July 19. Passed by House July 21. Referred to Senate Committee on Commerce July 14.
H. R. 7288	Mapes, Mich.—To require installation of wireless equipment on all vessels carrying passengers for fare and going out of sight of land. In Committee on Merchant Marine and Fisheries.
H. R. 7007	Britten, Ill., July 8.—To require all vessels 150 feet and over to carry wireless equipment. In Committee on Merchant Marine and Fisheries.
H. R. 5498	Greene, Mass., June 11.—Providing for sale and charter of Government-owned vessels. In Committee on Merchant Marine and Fisheries.
H. R. 3618	Alexander, Mo., May 28.—To protect halibut fisheries of Pacific Ocean. In Committee on Merchant Marine and Fisheries.
H. R. 3621	Alexander, Mo., May 28.—To establish loadlines for certain vessels. In Committee on Merchant Marine and Fisheries.
H. R. 5003	Greene, Mass., June 5.—To classify clerks of Steamboat Inspection Service. In Committee on Merchant Marine and Fisheries.
H. R. 4869	Fordney, Mich., June 4.—To amend provisions of Seamen's Act regarding arrests for desertion. In Commitee on Merchant Marine and Fisheries.
H. R. 491	Gould, N. Y., May 19.—To amend provisions of Seamen's Act regarding arrests for desertion. In Committee on Merchant Marine and Fisheries.
H. R. 1233	Edmonds, Pa., May 20.—To provide ocean mail steamship lines to South America. In Committee on Merchant Marine and Fisheries.
H. R. 3075	Nolan, Cal., May 26.—Prohibiting employment of other than American citizens as radio or telegraph operators on American vessels. In Committee on Merchant Marine and Fisheries.
H. R. 3617	Alexander, Mo., May 28.—To protect Alaskan fisheries. In Committee on Merchant Marine and Fisheries.
H. R. 3619	Alexander, Mo., May 28.—To abolish arrest and imprisonment for desertion. In Committee on Merchant Marine and Fisheries.
H. R. 3620	Alexander, Mo., May 28.—To authorize Commissioner of Navigation to change names of vessels. In Committee on Merchant Marine and Fisheries.
H. R. 4417	Walsh, Mass., June 2.—To establish a Department of Marine and Fisheries. In Committee on Merchant Marine and Fisheries.

suming that the entire fleet will eventually pass to private ownership. According to this plan the percentage of a ship's valuation represented by a purchaser's down payment would immediately be covered by a private insurance company, whereas the Government would continue to carry the remainder. This distribution of the risk would be revised at yearly or semi-yearly intervals in accordance with the gradual reduction of the mortgage held by the Government. This plan for Governmental participation in the marine insurance business is being urged on the plea that the marine insurance companies are not at this time strong enough to take over the total risks on the entire fleet, but that a plan of gradual transfer of risks will enable the private insurance interests to develop strength to bear the burden, and thus the Government can get out of the marine insurance business and the shipowning business at approximately the same time.

American Vessels to Be Insured in the United States

The sentiment expressed at the hearings on the insurance question was that it will be important for the United States to be as nearly self-sufficient as possible in the provision of marine insurance for its fleet as a means of withholding trade secrets from British or other foreign interests. Pursuing that same line of thought there was expression of the conviction that if the United States is to maintain a great merchant marine it is advisable to arrange for American facilities for every essential service—that is, for American registration of ships, loadlines, etc., as well as insurance. Incidentally, it was revealed that during the war the Shipping Board endeavored to give from 65 to 70 percent of all inspections to the American Bureau of Shipping and the remainder to Lloyds. Ability of the American institution to take the entire responsibility in future was intimated to be contingent to some extent upon their willingness to establish foreign branches that will, in some measure, parallel the service that Lloyds is now enabled to render through its agents in foreign countries.

William H. McGee, of the firm of William H. McGee & Company, of New York, appeared before the merchant marine sub-committee as the representative of twelve American marine insurance companies and spoke encouragingly of the possibilities for the development of American underwriting capacity. "Business begets capacity," he remarked. "Where there is business to be placed, the market will be found," and then went on to recite incidents illustrative of the change in conditions that has taken place since 1910, prior to which year it was, he said, difficult for an American shipowner to place more than 10 or 15 percent of the value of his vessel in the American market. At the same time Mr. McGee pointed out certain handicaps that are just now faced by the group of American companies that is in co-operation for the appointment of agencies throughout the world.

Stevenson Taylor Advocates Compulsory Loadline

Commander Stevenson Taylor, president of the American Bureau of Shipping, told the sub-committee the history of the institution of which he is the head and which he proclaimed it his ambition to have do for the American merchant marine what Lloyds has done for British shipping. When, however, Commander Taylor was asked for suggestions for legislation that would be helpful at this time he addressed himself to the necessity for the establishment in this country of a legal loadline. "We must have a law passed," he explained, "that will compel every sea-going vessel to have a loadline. The time is coming when we must have a loadline which must be established by the American Bureau of Shipping." Incidentally, he held out the hope that the spirit of opposition which has been potent in the past may be eliminated if distinctive classes of service, such as the coastwise trade and the Great Lakes trade, be considered separately and loadlines be fixed in accordance with their individual needs and limitations. "All these trades must be considered by themselves," he explained, "because they all differ."

Appearing in the capacity of vice-president of the American Bureau of Shipping, Commodore E. P. Bertholf likewise laid great emphasis upon the need for legislation establishing a loadline. He pointed out that, whereas the American Bureau of Shipping is now marking the loadline for the ships built for the emergency fleet, the loadline is not compulsory under the law, as is the case in other countries. He felt that just in proportion as the strength of the American merchant fleet has grown since the beginning of the war has this question of the loadline become acute. He took the view that, whereas uniformity of loadline requirements must wait upon the completion of the project already initiated by the International Conference on Safety at Sea, "the United States can go into that conference much better if backed by a loadline law."

Commander Bertholf also came out vigorously in favor of an all-American policy for all the ramifications of our merchant marine. Speaking to this text he said: "Every element that goes to make up what is called American shipping should be governed and controlled by Americans; otherwise it is not American shipping. There is no reason in the world why American shipowners should have their ships classed, insured or anything else abroad. You cannot expect the people abroad to lie awake nights to help American shipping as against their own shipping. Therefore all elements—the underwriters, the shipowners, the shipbuilders and the ship operators—should look to American institutions for those things they need. That is fundamental—American interests are best served in American institutions."

An Interesting Towing Feat

When the steamship *Alcona* was preparing to leave Balboa for Antofagasta recently, her chief engineer, Mr. Esmeraldo, was asked by an official of the United States Shipping Board whether he could tow to that port a French bark loaded with 3,000 tons of coal.

This was a serious proposal, for several reasons. In the first place, the *Alcona* was already deeply loaded. Secondly, the only hawser available was but 200 fathoms long, which would bring the bark within the back water of the steamer and thus make towing difficult. Thirdly, the screw of the *Alcona* was not proportioned for towing work, and, finally, the chief had no information as to how the ship's geared turbines would stand up under such a test. However, he had the greatest confidence in the *Alcona*, her equipment and her crew, and undertook the job.

The tow started, and fourteen and a half days later the *Alcona* and her charge finished the 2,000 nautical mile voyage without the slightest hitch. The machinery performed splendidly, without groaning or laboring, and with no undue heating at any point. The average speed was 6.3 knots and only a slight increase in the daily fuel consumption was noted.

The *Alcona* is a steel cargo steamer 335 feet long, 46 feet beam, and 28 feet 6 inches depth, of 3,658 gross tons, built last year for the Shipping Board by the Submarine Boat Corporation, Newark, N. J. The vessel's propelling machinery consists of two oil-fired watertube boilers and a set of Westinghouse geared turbines driving a single screw.

Shipbuilding in Foreign Countries in 1919

Output of American Shipyards Exceeds That of All Other Countries Combined—Great Britain Leads Foreign Builders—Japan Rapidly Forging Ahead

BY HARWOOD KOPPEL

IN 1918 the United States produced about 50 percent of the total number of merchant vessels launched and about 55 percent of the total tonnage of these vessels, in all, 929 ships of some 3,033,030 tons, which was three times the number produced in the United Kingdom, where 301 were put overboard. The British Dominions, however, launched 206 more craft. The tonnage of the vessels constructed in the United Kingdom was 1,348,120, considerably less than half of that produced in the United States, and with the 279,904 additional tons produced in the Dominions only equaled a bit more than half of the tonnage produced in this country. The British output for 1918 was smaller, however, than the output for the preceding year, when 1,162,896 tons were produced in the United Kingdom and 94,471 tons in addition in the Dominions. In that year the number of vessels constructed was smaller, however, for but 286 were turned out in the United Kingdom and 105 in the Dominions.

French Yards Inactive

France had almost ceased shipbuilding activities in 1918, turning out only three vessels of a combined tonnage of 13,715. Although France was never a great shipbuilding nation, her greatest achievement in recent years was in 1913, when she turned out 89 vessels of some 176,095 tons. Figures are not available for German and Austrian shipbuilding during the war, but with incomplete returns for 1914, Germany built 89 vessels of 387,192 tons. The previous year the German Empire had constructed 465,226 tons of shipping divided into 162 vessels.

The United States in 1914 launched 94 merchant craft of some 200,762 tons, while Great Britain put over 736 vessels of 1,731,087 tons. Japan, which in 1914 built but 32 ships of 85,861 tons, had by 1918 reached an output of 489,924 tons, comprising 198 vessels. During the previous year (1917), Japanese shipbuilding plants launched 104 vessels of 350,141 tons.

These figures, which are taken from Lloyds Register of Shipping, do not include warships nor vessels built to government order for other than mercantile purposes and include only vessels above 100 tons which were launched in 1918, irrespective of whether they were completed during that year or are now receiving their finishing touches. All sorts of shipping is included, however—steel,, composite, concrete and wood, and steamships, motorships and sailing ships. The United Kingdom put over the largest mercantile ship, the *Narkunda*, of 14,500 tons gross.

Output of Smaller Nations

Denmark turned out 13 vessels of 26,150 tons; the Netherlands, 74 craft of 74,026 tons; Italy, 15 ships of 60,791 tons; Norway, 51 merchantmen of 47,723 tons, and Sweden, 36 liners of 39,583 tons. All of the other countries combined only produced 34,478 tons, with returns not quite complete. This was divided into some 40 ships. The world total was 1,866 vessels of 5,447,444 tons.

Figures issued by the American Government for the twelve months ending March 31 show a total of 2,056 vessels launched of some 3,225,521 gross tons. Of these, 538 were steel vessels fit for going to sea, amounting to 2,178,939 tons, and 436 wooden seagoing ships of 916,037 tons. These figures do not agree with Lloyds, nor do the figures for 1918 given out by the Government for vessels "built in the United States and officially numbered by the Bureau of Navigation, Department of Commerce," agree with Lloyds, but this is explained by the fact that Lloyds figures are for vessels launched only, and do not include craft of less than 100 tons, while the Government figures are for all classes of craft, seagoing and otherwise, of any tonnage. The Government is modest and shows only 821 vessels against Lloyds 929 for seagoing purposes, and only 2,597,026 tons of seagoing shipping against Lloyds 3,033,030 tons.

Tonnage Building Throughout the World

At present, according to Lloyds, there are 2,189 vessels of 6,921,989 tons being built throughout the world, and of these 1,427 are of steel, comprising a tonnage of 5,665,434. The wooden vessels comprise 1,151,828 tons, divided into 591 craft. In this lot there are 13 steel sailing vessels of 12,215 tons and 158 wooden sailing ships of 89,512 tons. The total tonnage under construction is double that of the world before the beginning of the war. Concrete vessels are included in the steel tonnage. There are 14 under construction now, of some 26,370 tons.

Of the foreign countries the United Kingdom is building the greatest number, there being 414 steel vessels of 1,975,962 tons under way there and 2 wood ships of 1,240 tons, while our next door neighbor, Canada, is busy with 31 steel ships building on the Great Lakes and 21 on the coast. The Lakes tonnage is 62,990 and the coast 76,666. All of the other British Dominions combined are building only 9 steel ships of 40,402 tons. Canada is also building one wooden craft of 2,400 tons on the Lakes and 48 wooden vessels of 61,139 tons on the coast, while the other Dominions are building 10 wooden ships of 4,858 tons.

Opportunity to Export American Materials

Aside from the ships to be constructed in the United States in the near future, this country should prepare for a still further enormous expansion of the material industry, particularly in plates. This, in the opinion of the writer, will be due largely to the fact that with the rich iron and coal regions of the former German Empire in French possession, Germany will not be in a position to compete with this country in shipbuilding material, while Great Britain can use practically all of its own output in its own industry, and France, which will have the working of the Alsace and Lorraine ore mines and the Sarre Valley coal mines, will need its steel output for industrial purposes other than shipbuilding. Should France decide upon a comprehensive programme of shipbuilding, which is likely, since at present there are but 12 steel ships of 51,690 tons being constructed there, there will be a further demand on the French ore deposits—for the benefit of France only—and the field will practically be cleared for the United States to step in and gain a strangle hold on this valuable and profitable foreign trade. Should some of the French ore go to Germany, it is unquestionable

that the Germans can use this steel to better advantage in rebuilding their own merchant marine, which has suffered much at the hands of the Allies, than in re-exporting it to other countries, and even if they do so they cannot do it at the relative underselling that had once been their wont.

At present Japan does not have under construction the amount of shipping that she turned out in 1918, as there are only 89 steel vessels of 257,777 tons on the ways, but further additions are expected from time to time, and the figures for the present year will undoubtedly be as high as they were last year, if not higher. There are also 27 wooden ships of 20,363 tons under construction in the Island Empire.

Holland is building 113 steel ships of 212,512 tons; Norway, 54 of 62,157 tons; Sweden, 48 of 89,368 tons, and Denmark, 45 of 70,258 tons. Italy is building ships of larger type, for the 20 steel vessels under construction there are of 112,300 tons. The Italians are also working on 26 wooden craft of 16,500 tons. China is constructing 6 steel ships of 8,968 tons and 10 wooden ones of 4,858 tons, and Spain 30 steel vessels of 76,335 tons.

Scandinavian Shipbuilding

Shipbuilding in Scandinavia will undoubtedly be encouraged by the sale of many vessels now owned in these countries, which are to be offered to foreign buyers. For instance, Norway during the war prohibited its ship owners from disposing of their vessels to the nationals of other countries, belligerent or neutral, but the Norwegian Steamship Owner's Union has petitioned the government that the prohibition against the sale of ships to foreigners be cancelled. Failing in this, they desire that they at least be permitted to sell all ships over twenty years old and all ships bought during the war, irrespective of their age, and all wooden and concrete ships. This association naïvely points out that the owners can now secure good prices for these ships, which will enable them to build new ones for what they receive for these obsolete craft, which will be a big stimulus to the shipbuilding industry of the country, and, anyway, most of the ships purchased during the war are uneconomical and in poor shape.

In order to economize on shipping space on lumber, Aktieselskabet Maraker Bruk in Norway is building a lumber raft to be towed across the North Sea. The lumber in this raft would require 5,000 tons of shipping to carry it across, and it is considerably larger than the raft which was towed some time ago from Finland to Copenhagen. Captain Gardiner, of the Gardiner Shipbuilding Company, is directing the construction of this raft and will supervise the building of a number of others.

But, on the whole, work is not progressing at a rate which one might expect with the shortage of tonnage due to the losses of the Norwegian shipowners during the war. Inability to secure necessary materials is given as one of the principal reasons, one of the delays being due to the fact that orders for 25,000 tons of plates placed in Germany some time ago have not materialized as yet, and the prospects are that when the Germans have such a quantity of plates they will go to German and not Norwegian shipyards.

In Sweden there are signs of renewed shipbuilding activity, mostly seen in the expansion of capital by various firms and the organization of new companies. The fact that the Swedish iron mines produce such high-grade ore, from which plates were made and exported during the war as high as $250 (52/1/8) a ton, has had the effect of causing the rolling mill owners to seek a market for their product in other countries, rather than use their plates in their own shipyards. In the days before the war Sweden imported shipbuilding plates from Germany and Great Britain. The Germans are reported as already making bids for the Swedish trade on plates, quoting prices of $50 (10/8/4) per ton, f.o.b. German ports; but the inability of the German exporters to give a guarantee of the time of delivery, due to the disturbed economic condition of Germany, has deterred Swedish shipbuilders from placing heavy orders.

American Shipbuilding Materials for Denmark

American exporters of shipbuilding materials are being encouraged by the shipbuilders of Odense, Denmark, who realize that the American materials are in a better position to compete with German materials than in the years preceding the war. American steel exporters have already been approached by A. P. Mollers Staalskibsvaerft, which placed a ship construction plant in operation early this year. This firm has secured a site near the mouth of the Odense Canal, where it empties into Odense Fjord, there being a convenient bend here for launching ships.

This yard is to be one of considerable size, as about 15,000 tons of shipping will be constructed each year. A force of 500 men will be employed, and the company will specialize on ships of 3,500 tons. The machinery for the plant, which was ordered in Denmark, has been received and installed, and work was begun on the first ship in January.

This company desires to purchase a floating dock in the United States, and there is a splendid chance for the builders of docks to secure a handsome order by getting in touch with these people.

Svendborg, one of Denmark's important ports, just about 25 miles across the Little Belt from the German coast, is also experiencing a boom in its shipbuilding industry. Yards were first established in this place about twelve years ago, and during the war were expanded to large proportions. The Svendborg Skibsvaerft og Maskinbyggeri, which operates this yard, is now busy securing prices on steel from the United States suitable for its work.

In Denmark the Burmeister & Wain shipyard recently completed the *Bonheur*, a 7,133-ton motorship, for Fred Olsen & Company, a prominent Norwegian shipowning firm. This is the largest motorship flying the Norwegian flag. Her maiden trip was made to Buenos Aires to secure a cargo of grain for the Norwegian Government.

Japan's Rapid Strides in Shipbuilding

"Vast" is the only word that adequately describes the shipbuilding programme of Japan, for nearly all of the leading shipbuilding firms of the country are to be extremely busy. The Kawasaki Dock Company has announced an increase in capital to $24,900,000 (£5,100,000), with the statement that the greater part of the new shares would be given to the workmen who have worked faithfully in the company's service. K. Matsukata, president of this company, spent three years in England, and since his return to Japan the company has not only increased its capital but shows other signs of activity. The Daifuku Steamship Company, with a capital of $9,960,000 (£2,040,000) has also been established by Mr. Matsukata, and a large chemical factory as allied industries with his shipbuilding plant.

The Mitsubishi Shipbuilding Company, with plants at Kobe and Nagasaki, the Kawasaki Dock Company of Kobe, and the Asano Shipbuilding Company of Yokohama, the Uraga Dock Company and others, are all ex-

panding on a large scale, for 181 steamers of more than 1,000 tons deadweight, and in all aggregating 1,189,285 tons, are to be constructed in the little Island Empire this year.

The Kawasaki Dock Company is to construct 37 of these vessels, aggregating 330,000 tons; the Uraga Dock Company is to build twelve, of 91,260 tons; the Asano Shipbuilding Company is to turn out ten vessels of 88,000 tons, and the Mitsubishi Shipbuilding Company is to construct ten ships at Nagasaki of 74,300 tons and six at Kobe of 33,500 tons. The Osaka Iron Works is to build nine vessels of 83,000 tons at Sakurajima and eight of 74,000 tons at Innoshima.

Contracts for the others range from eight, aggregating 67,500 tons, with one of the companies down to only one vessel of 2,000 tons with another.

Chinese Shipyards Active

More activity is also manifested at the Chinese shipyards of Shanghai. The Kiangnan dockyards, where in the last ten years 316 ships have been constructed, mostly by hand, and a number for the use of the American Government for use in Philippine waters, are said to be unusually busy. Repair work, however, was responsible for the better part of this activity, but new work is also in sight. Using, as it does, hand labor, the plant would be called antiquated if compared with a modern American or European shipyard, but it gets along in its own unobtrusive way, as evidenced by its record of 31 vessels a year constructed, and its workmanship is so highly thought of that Lloyds will insure the vessels built here for twenty years.

This plant is located on the Whangpo River above both the native city and the foreign settlement. It is under the direction of Admiral Liu and Mr. Kwong, Sr., but its technical administration is in charge of a number of Europeans and Chinese. That much new work is to be done may be judged from the fact that five new ways are under construction and the present ways already line the Whangpo River for several thousand feet. A 1,200-ton ship of the composite type, with steel frames and wood sheathing, is partially completed. When the plate situation eases up sufficiently for the steel plates to be secured, work is to be started on several steel ships.

Repair work occupies much of the energy of the plant at present, and it is well arranged to handle such work. There is a dry dock of 523 feet which opens into the Whangpo River, where there is 16 feet of water even at mean low tide. New outside cranes are being erected, which will materially increase the efficiency of the plant.

Canada Building Up Shipbuilding Industry

Our next door neighbors, the Canadians, are alive to the possibilities of ship construction, and even during the winter, when numbers of Canadian seaports are virtually closed, the shipyards have not been idle. This was particularly true at Quebec and at Levis, across the river from that city.

Ways have been constructed by the Quebec Shipbuilding & Repair Company, and lumber is arriving for the construction of two wooden schooners at the new plant of this concern. The Canadian Government some time ago awarded the Davie Shipbuilding Company at Levis a contract for two 5,000-ton steel steamships, and only the inability of the company to secure steel plates and other materials prevented actual work being started on these vessels several months ago. This plant has been busy, nevertheless, constructing six steam trawlers for the Imperial Shipping Board. These craft are of 375 tons each and will soon be completed. Two barges built in the United States, which were brought down through the Great Lakes, were joined together at these yards, as they had to be cut into two sections to make the voyage.

The Canadian Government had contracted for a dry dock and shops here, and this plant will be in operation within a very short time. Delay in the construction of the boiler, pattern, machine and forge shops has held back its opening, but the dry dock proper is in a position to receive ships.

New Yard for Holland

Holland is to have a new big shipyard between Schiedam and Vlaardingen on the New Waterway between the Hook of Holland and Rotterdam. This is to be directed by the chief engineer of the Ministry of Public Works, Dr. A. T. de Groot, who has requested a leave of absence for three years. It is to be operated and owned by the Wilton Machine Factory & Shipyard, which concern purchased 173 acres of land for that purpose. According to reports the docks will be of the basin type, below the level of the water in the Maas. One of these docks will be large enough to enable the company to construct two vessels of about 650 feet each and eight craft of 325 feet each all at the same time. A second dock will be constructed to accommodate a 1,000-foot vessel. In conjunction with these ways a floating dock will be constructed in which ships of 40,000 tons may be docked. According to the *Nieuwe Financier en Kapitalist*, an important periodical of Holland, this will be the largest shipbuilding plant in Europe.

Italy Needs New Tonnage

Italy some time ago was busy building ships with material furnished by Great Britain. The Consorizo Construttori Navali, or Association of Naval Builders, had contracts for twelve freighters of 8,000 deadweight tons each and one for a vessel of 6,000 tons. This contract was given early in 1917, when it was estimated that it would take several years to complete the job. Some 40,000 tons of material were purchased in England and arrangements made with the British Government to expedite the shipments of these supplies. As to what the present condition of this contract is it is hard to say.

Italian shipping losses during the war have been estimated as high as 60 percent, on which basis it is believed that about 3,000,000 tons of new vessels will be required both to replace these losses and to take care of future needs. Practically all of this is yet to be built, as reports are to the effect that only some 150,000 tons have been completed so far.

Fuel Oil Dangers.—According to a memorandum issued by the marine department of the British Board of Trade, cases have been reported recently in which men employed in cleaning or carrying out repairs in oil tanks, or in working cargo in holds situated above double-bottom tanks in which fuel oil is carried, have been asphyxiated or poisoned by the fumes or gases given off from the oil or cargo. To guard against such accidents, the Board of Trade has issued the following recommendations:

When fuel oil is carried, whether in double bottoms or elsewhere, care should be exercised that the tanks containing the oil are thoroughly oil-tight.

The utmost care should be taken to ventilate thoroughly all spaces in which oil has been carried, as well as any adjacent spaces in which vapor may have accumulated, before men are allowed to enter such spaces. Thorough ventilation is necessary in all cases.

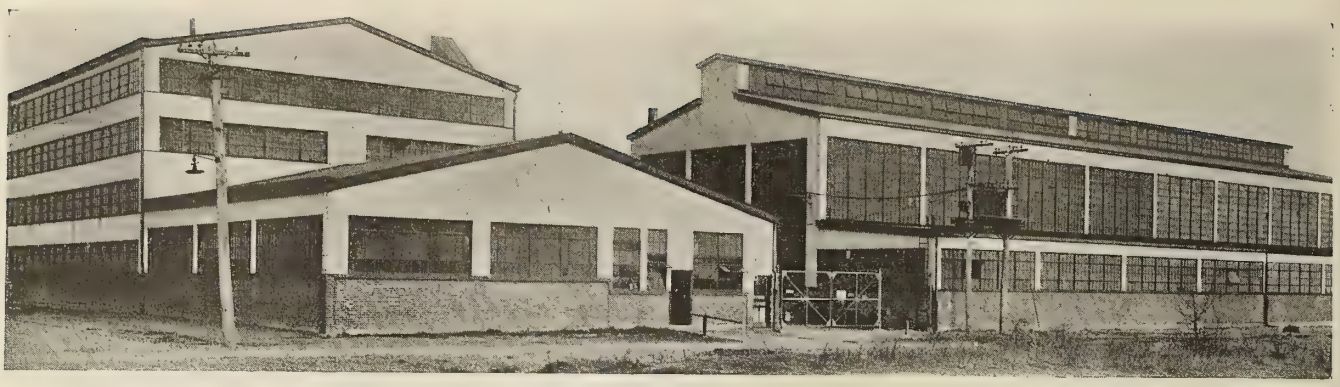


Fig. 1.—Corner of Plant of Staten Island Shipbuilding Company

Staten Island Shipyard Greatly Enlarged to Meet Demands for War Work

IN April, 1917, the Staten Island Shipbuilding Company, New Brighton, N. Y., operated a plant at Port Richmond, Staten Island, engaged chiefly in building tugboats, repairing barges, dredges and steam yachts. Here also marine Scotch boilers and reciprocating engines were built and repaired. In addition, a small auxiliary yard existed at Mariner's Harbor, where two ways and a few shops cared for the overflow from the Port Richmond plant. Immediately after the entrance of this country into the war it was decided by the officers that future developments of the plant to care for the demands of the government must be made at the Mariner's Harbor yard because of the space available at that location.

Additions to the Plant

To this end a certain amount of new construction became necessary at once. Between that time and the early part of 1919 the company had constructed a new four-story concrete and brick office building, 92 feet by 48 feet; a boiler shop, 60 feet by 250 feet; an auxiliary shop for stack work, 40 feet by 200 feet; a four-story concrete storehouse, 69 feet by 77 feet; a 187-foot by 42-foot frame and angle shop, and a warehouse, 40 feet by 200 feet at the foundry. The existing mold loft, 130 feet by 225 feet, was remodeled and storerooms and shops fitted out on the first floor for joiner work, mold storage and millwright shops, and an addition to the plate shop was also made.

Two new concrete ways, 400 feet by 60 feet, have been completed and will adequately care for the construction of ships of 10,000 tons displacement. A unique feature of these ways is the arrangement of space beneath them for rivet storage, pneumatic tool storage, a riggers' loft and offices for the foremen.

The main joiner shop and machine shops are at the



Fig. 2.—Mold Loft with Storerooms and Joiner and Millwright Shops on First Floor

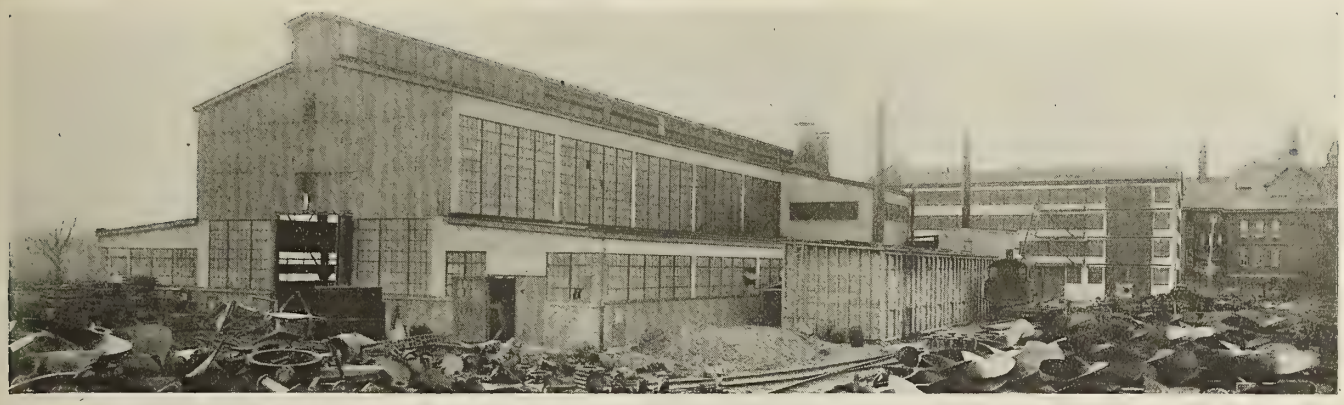


Fig. 3.—Foundry and Storage Yard for Castings

Port Richmond plant. This latter is now being used entirely for hull repair work on tugs, mine sweepers, barges and freighters, as well as for boiler and engine work, including both new construction and repairing.

Power Plant

The Mariner's Harbor yard is not large, but is laid out so that material may be handled in a most efficient manner. Power is supplied to the yard by the Richmond Light & Railroad Company at 6,600 volts and is transformed by three 5,000-kilowatt transformers to 440 volts and 220 volts for generators, electrical equipment and light in the yard. About 2,000 horsepower is used. There are two generator sets, totalling 200 horsepower, consisting of an Allis-Chalmers direct-current 200-volt, 600-ampere generator, driven by a 225-kilowatt motor, and a Westinghouse 220-volt, 250-ampere installation. Four compressors are required to supply the air for pneumatic equipment in the shops, as well as the pipe lines to the ships. One Worthington compressor with a capacity of 4,200 cubic feet per second and two Worthington compressors each with a capacity of 1,600 cubic feet per second maintain a pressure of 100 pounds in all the lines through the yard, with the exception of the boiler shop, where a pressure of 120 pounds was maintained by a 9-inch by 8-inch high-speed compressor supplied by the Chicago Pneumatic Tool Company.

The mold loft has sufficient floor space to lay out any of the ships that will be built in the plant. Beneath the mold loft, as already indicated, joiner and millwright shops are located, as well as storage spaces for these departments and the molds.

Angle Shop

In the angle shop two brick furnaces, built by the Quigley Furnace Specialties Company, are installed for plate and frame heating. The plate furnace is 13 feet by 30 feet, and that for the angles 2 feet 6 inches by 66 feet. The shop also includes a Quigley bar-heating furnace to supply an Acme 1¾-inch rivet-making machine, a 22-inch Hammond double-chamber furnace, two pneumatic hammers, one of 1,000 pounds and the other somewhat smaller, one electrical Porter & McDougal trip hammer for plate liners, and small forges for rivet and blacksmith work.

The main blacksmith shop is at the Port Richmond yard. All frames and angles are cut to shape and arc welded. General Electric equipment is utilized for this



Fig. 4.—New Ways and Cranes



Fig. 5.—Angle Shop, Bending Floor Furnaces, Blacksmith Shop

work, while Oxweld apparatus is used for the oxy-acetylene welding that is done on castings.

Plate Shop

Tracks are laid from the plate shop, which is at the head of the ways, on either side of the ways to supply the ships under construction with material. The plate shop is equipped with machines adequate to care for any ships that may be constructed in the yard. This equipment includes a 5-ton Pawling & Harnischfeger crane and seven 3-ton jib cranes for the punches and other machines. The punches are one 3-foot 8-inch gap Cleveland for ¾-inch plates; one 3-foot gap Hilles & Jones for ⅝-inch plates; one 4-foot 6-inch gap Hilles & Jones; one horizontal punch for heavier work made by the Long & Allstatter Company, and another small Hilles & Jones machine. Three shears are sufficient for the needs of the shop; one is a Long & Allstatter, one a Hilles & Jones, and the third a special rotary cutter made by the Quickwork Company and capable of handling ½-inch material. One 22-foot Niles-Bement-Pond plate planer and one 25-foot Hilles & Jones planer are installed, as well as a Hugh Smith 1,500-pound hydraulic bending and joggling machine, built at the Possil Works, Glasgow, Scotland. This

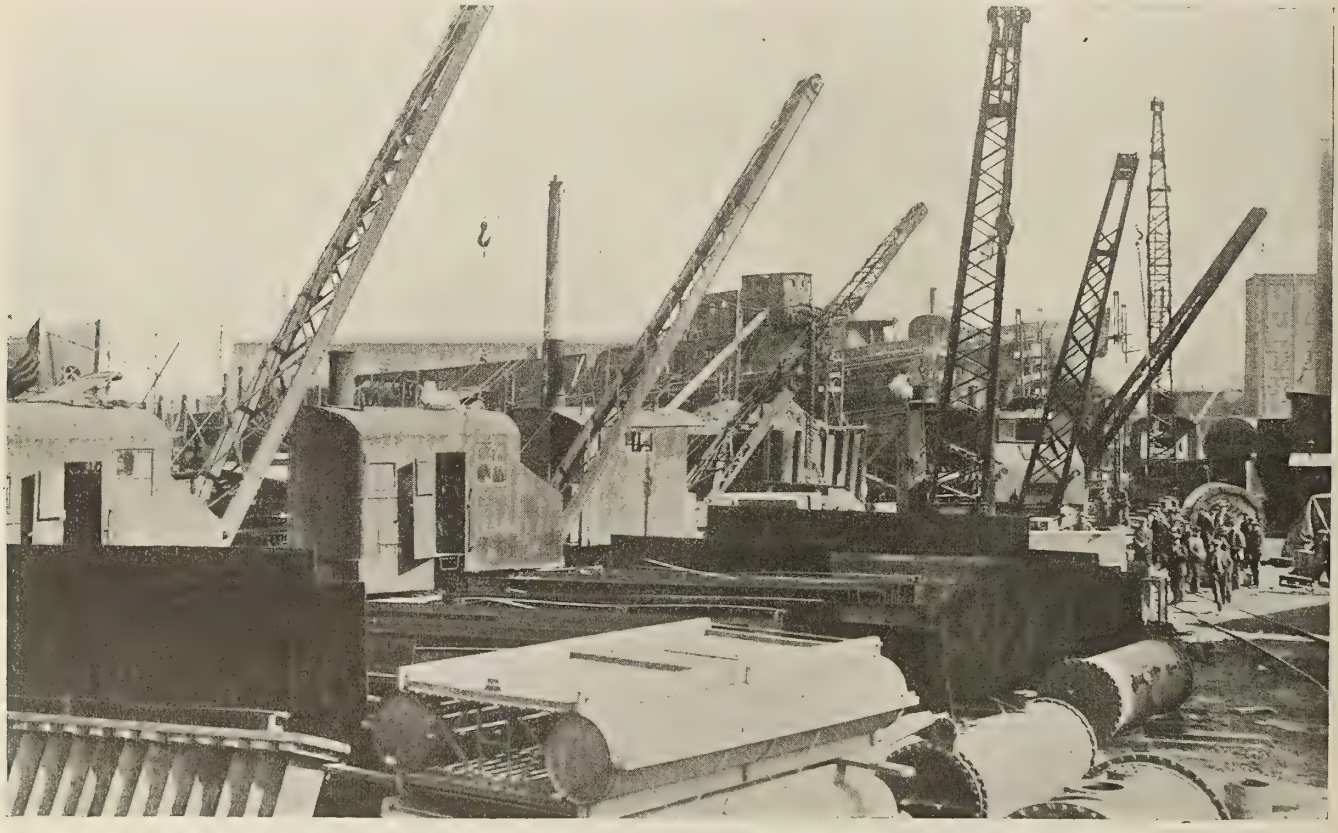


Fig. 6.—View Showing Locomotive Cranes Which Are Used for Handling Materials Throughout the Yard



Fig. 7.—Repairing Ships Is One of the Most Important Features of the Staten Island Yard



Fig. 8.—Dry Docks and Fitting-Out Slips



Fig. 9.—Main Office

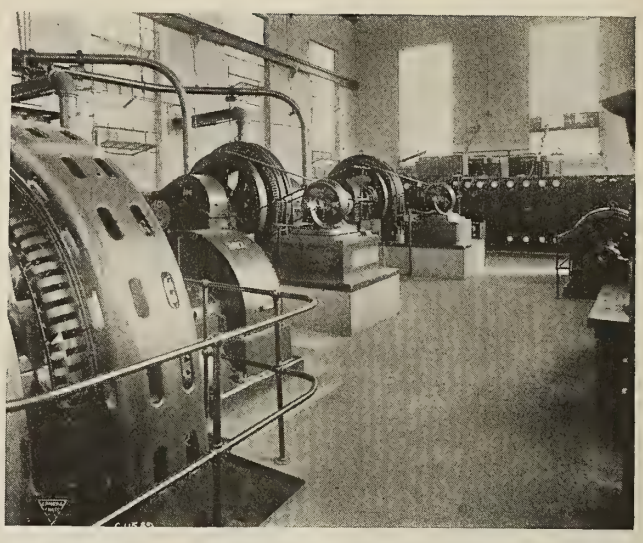


Fig. 10.—Power Plant

machine is capable of handling plates and angles up to 1⅝ inches. A set of 18-foot Niles Tool Works rolls, capable of handling plates up to 1¼ inches in thickness; two countersink drills made by the Dietrick & Harvey Machine Works, together with one Fitchburg Machine Works drill and one drill press care for all the drilling necessary in the plant. A special plate-scarfing machine, which bevels the plates so that liners are not necessary, has been installed in the last few months. To facilitate the labor of producing such parts as the stem bar and stern frame, a Gould & Eberhardt shaper is installed in the shop. A Lambies hydraulic flanging press is also included in the equipment.

Boiler Shops

There are two boiler shops built of brick and steel with modern daylight window arrangements. The main plant is 250 feet by 60 feet and has an extension at one side 40 feet by 60 feet for the flanging machinery and heating furnaces. About half of one of the walls of the building is built of tile, so that additions may be made to care for

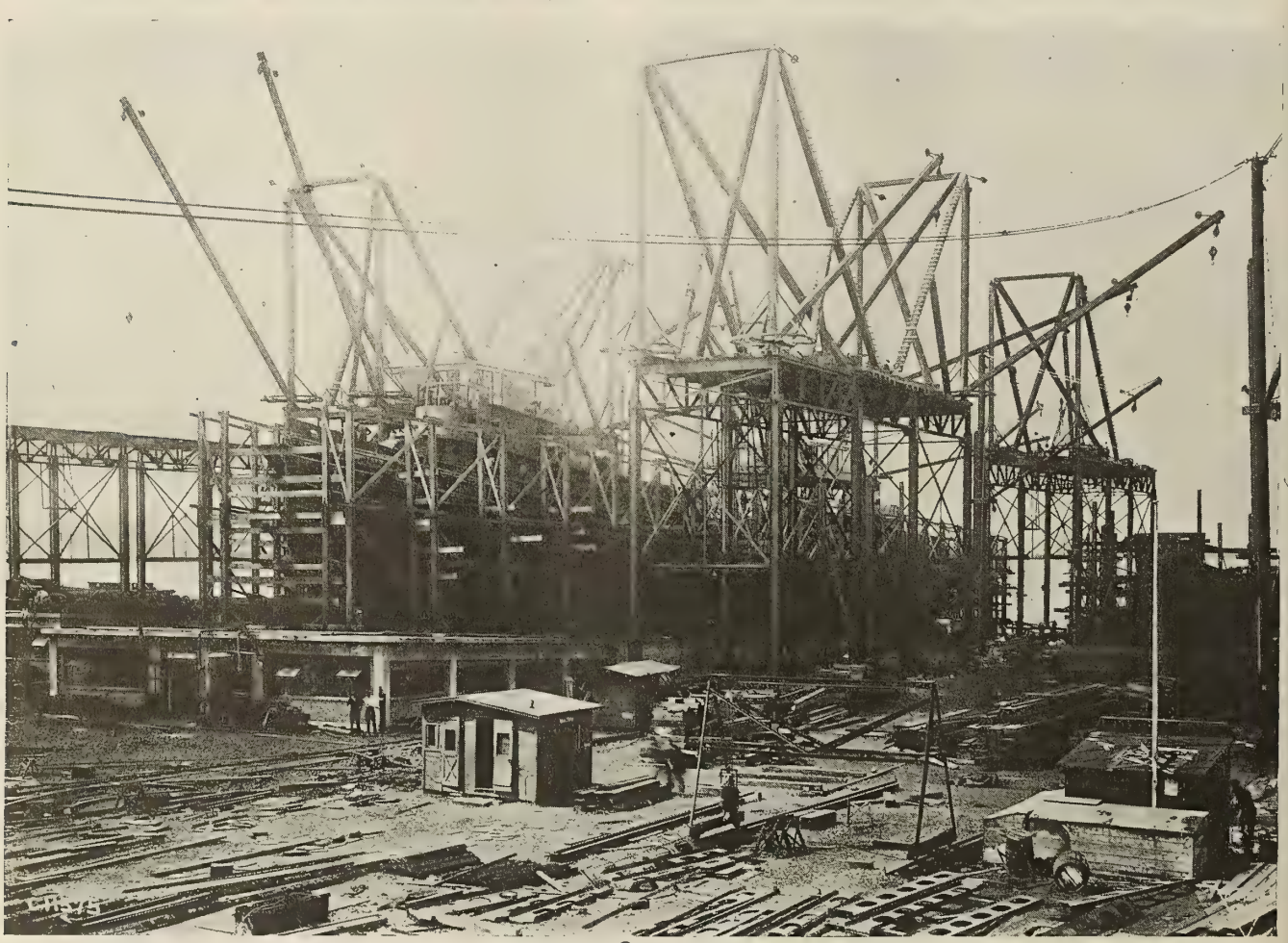


Fig. 11.—New Concrete Shipway



Fig. 12.—New Boiler Shop



Fig. 13.—Interior of Boiler Shop

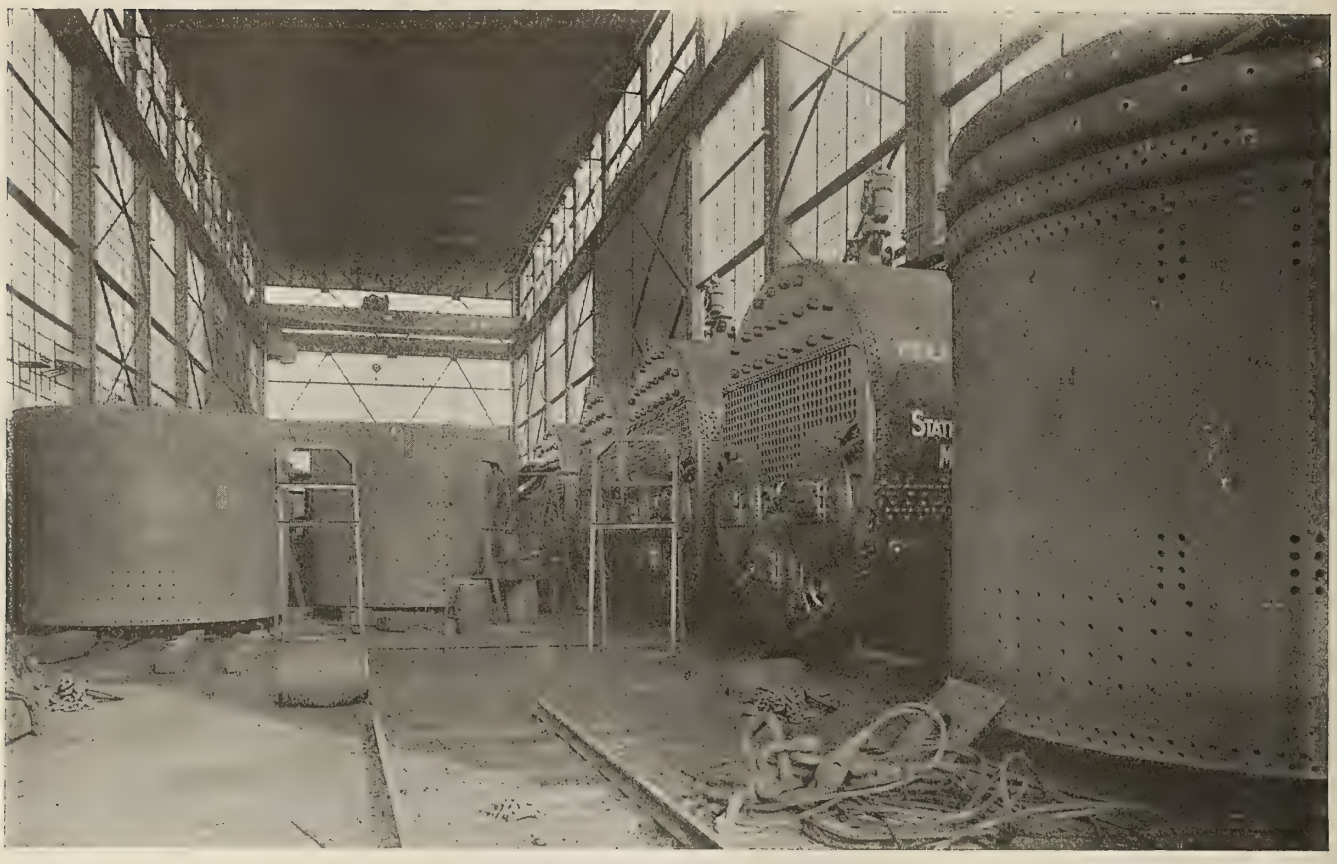


Fig. 14.—Testing Floor of Boiler Shop



Fig. 15.—Main Floor of Boiler Shop; Flanging Press in Extension at the Right

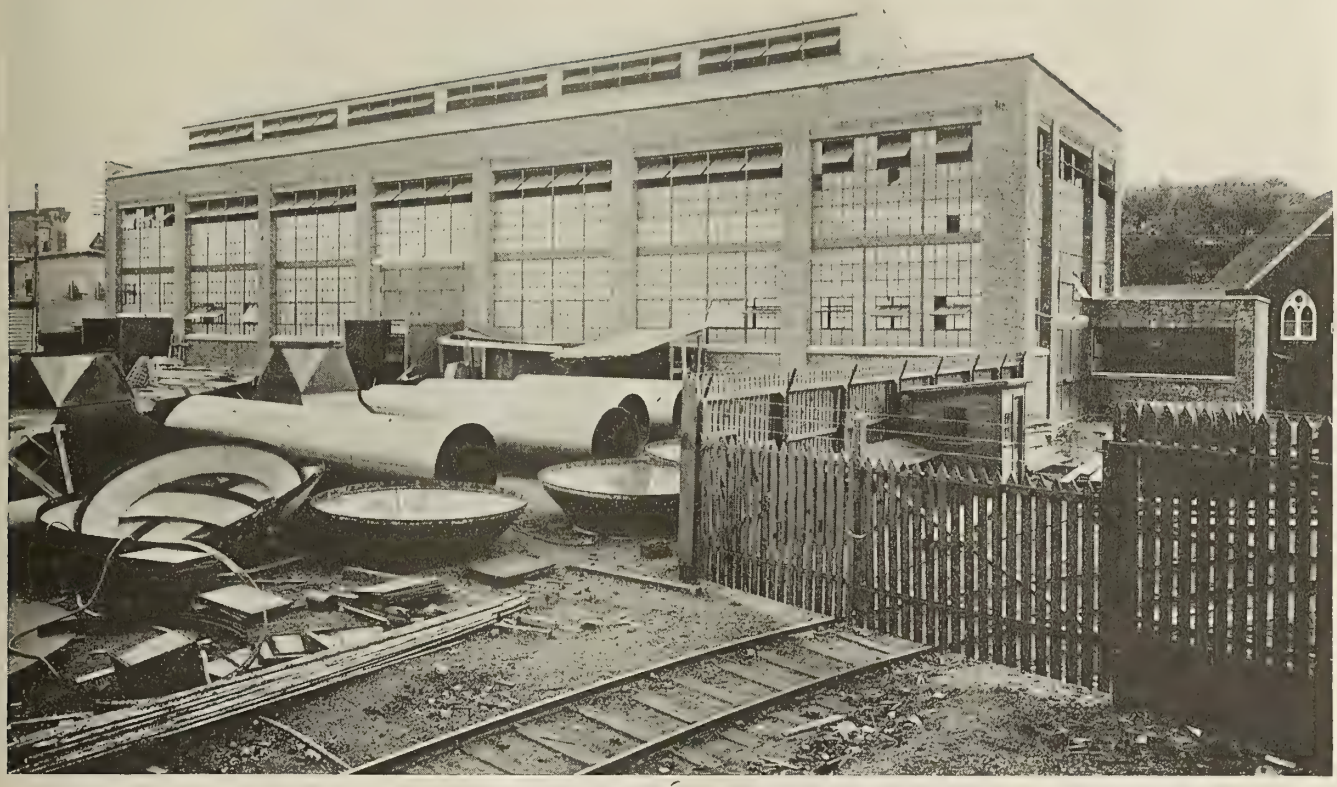


Fig. 16.—Auxiliary Boiler Shop

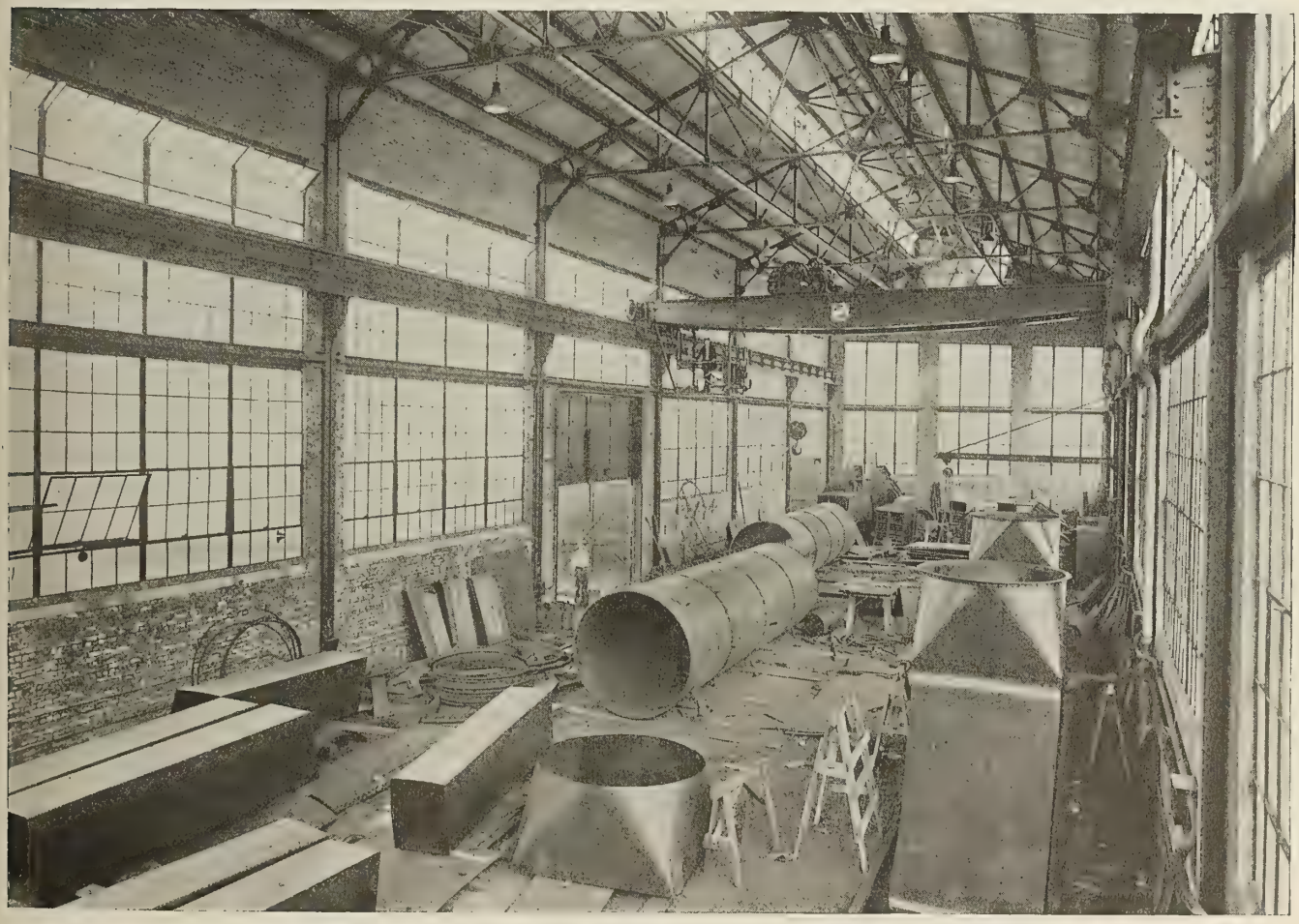


Fig. 17.—Tank and Stack Work Under Construction in Auxiliary Boiler Shop

future expansion without the necessity of tearing down the brick work.

Boilers up to a diameter of 17 feet can be built without difficulty, and at the present time one boiler is being completed a week. With certain additions to the equipment and space planned in the near future, the desired capacity of seventy boilers a year will be easily attained. Marine Scotch boilers have been specialized upon, and all the work of the shop is devoted to this type. All repair work is carried on in the old plant at Port Richmond. About eighty men are employed in the two shops.

Auxiliary Boiler Shop

Soon after the erection of the main shop in 1918, it was decided that the entire capacity would be required for boiler work, so that it became necessary to erect an auxiliary shop for building tanks, stacks, uptakes and the like required by the ships under construction in the yard. This shop is smaller than the main one, being 40 feet by 200 feet. It has only such equipment as punches, drills and pneumatic riveters for handling the thin metal used in stack work. A great deal of this consists in building small type funnels for tugboats and mine sweepers, although stacks as large as 9 feet in diameter and 40 feet long have been fabricated for freight ships. A 10-ton Milwaukee traveling crane is used to handle material in this shop, while two jib cranes facilitate the work of punching plates by holding them in position.

Since completion, the boiler shop has supplied all the boilers necessary for ships constructed in the yard, and in addition has turned out boilers for the Downey Shipbuilding Corporation, Texas Company, Standard Oil Company, Providence Engineering Corporation, and others.

Equipment

The same difficulty of getting the desired equipment during the war period was experienced here as elsewhere, but practically all of the machines essential to good boiler work have been installed. The entire machine installation is of the most modern type, and the crane equipment is exceptional.

A list of machines includes: One 8-foot radial Ridgeway drill; one 6-foot radial Ridgeway drill, both manufactured by the Niles-Bement-Pond Company; one 21-foot Niles-Bement-Pond plate planer; two Garvin turret lathes; one Hurlbut-Rogers staybolt cutter; three Acme screw machines, one of which is of the double type; one Morgan 100-ton flanging press; one Morgan 100-ton, 12-foot gap hydraulic bull riveter; one Morgan 100-ton, 6-foot gap hydraulic bull riveter; one 1,500-pound pressure hydraulic accumulator, designed by the engineering department of the Staten Island Shipbuilding Company. One Milwaukee 20-ton traveling crane handles lesser weights, while a two-hook Pawling & Harnischfeger crane has a capacity on one hook of 35 tons and on the other of 75 tons. The latter is said to be one of the largest cranes near New York. The equipment of the shop does not include gang drills, so that a great deal of the drilling must be done with pneumatic hand drills. Tracks are laid to the doors of each of the shops so that locomotive cranes from the yard can handle material until taken care of by the cranes in the shops. The completed boilers are loaded onto special trucks by means of the plant crane and carried on tracks to the docks. If they are to be installed in company ships, they are dropped into place by lighter cranes, while if intended for shipment they are loaded on the lighter.

The foundry, situated within a short distance of the yard, includes a pattern shop, molding shop, core room and casting floors, as well as a warehouse which at present contains about 20,000 patterns of all sizes, both for marine and other castings. The equipment is very complete, and castings up to 20 tons may be made. The capacity of the plant is about 35 tons of castings a day, which are used to supply the Staten Island Shipbuilding Company as well as outside plants. Among others supplied are The Downey Shipbuilding Corporation, Standard Shipbuilding Corporation, Providence Engineering Corporation, Todd Shipbuilding Company, Morse Shipbuilding Company, Vulcan Iron Works, Baltimore & Ohio Railroad and others. Propellers up to 20 feet in diameter can be cast without difficulty. Two complete sets of reciprocating engine castings can be turned out a week in addition to ordinary propeller work.

The two electric cranes, one a 15-ton Milwaukee and the other a 10-ton Whiting, handle castings on the molding floor. On the side floor are one 3-ton Roper Crane Works electric and one 2-ton Brownhoist crane. In the main bay are two 2-ton Yale & Towne jib cranes. The cleaning department has one 4-ton crane and the core room one 2-ton Brownhoist. Two 10-ton locomotive cranes handle material in the yard.

Pneumatic hand rammers, made by the Ingersoll-Rand and the Cleveland Pneumatic Tool Works, are used in forming molds. On the molding and side floors are two sand mixers, one an electric-driven Lystone and the other a belt-driven Willoughby machine. The core room contains a Wadsworth machine for core making and a small slide drawing oven 25 feet by 10 feet 2 inches. This oven has a bottom draft and flue and a duct around the firebox. A 25-foot by 17-foot oven is also installed. Castings are in many cases cleaned in a 16-foot by 16-foot concrete room by a Paxson & Warren sand blast and exhaust system.

Two cupolas supply metal to the floor. One, a No. 6 Whiting, has a capacity of 9 tons an hour, while the other, a No. 3 Whiting, will supply 4 tons an hour, if pushed. Its normal capacity is only 3 tons of metal an hour.

New Ways

As already indicated, there are four ways in the yard, two of which are new, of reinforced concrete construction, 400 feet by 60 feet, while the other two are somewhat smaller but will accommodate vessels up to 3,500 tons. Under the new ways are arranged offices for the foremen and pneumatic tool and rivet storage spaces.

The crane equipment is complete, consisting of six new 50-foot steel derrick towers between the old and the new ways. Each of the towers has four 5-ton electrically operated derricks, so that the largest ways are supplied by eight and the smaller by four booms. Two fitting-out docks on either side of the ways are also taken care of by these derricks, while three dry docks for repair work have a capacity for ships up to 5,000 tons.

The entire yard is laid with track so that material may be handled by locomotive cranes, of which there are seven. Three Industrial Works cranes are all of the same capacity, i. e., 2,500 pounds at a 10-foot radius of the jack beam and 4,730 pounds at a 40-foot radius. The largest of the cranes, built by the Brown Hoisting Machinery Company, has a lifting power of 29,500 pounds at a 16-foot radius, and 6,200 pounds at 50 feet. As the boilers built at the plant are too heavy to be handled by these cranes, they are transported or installed on lighters by cranes supplied by the Merritt & Chapman Derrick & Wrecking Company.

War Output of the Plant

In the period from April, 1917, to March, 1919, the keels of eighteen ships of various types were laid at the

Mariner's Harbor yard, as well as a great amount of repair work carried on, both at this plant and at Port Richmond. Repairs included the remodeling of private yachts for war service, the rebuilding of engines and the repairing of two interned German liners which had been disabled by their crews.

Of the eighteen vessels laid down, six were 3,500-ton ships originally intended for the Cunard Line, but were taken over by the United States Shipping Board in the emergency, six were mine sweepers and six naval tugs. The machine shops at Port Richmond supplied all these ships with reciprocating engines, steering engines, condensers, thrust bearings, shafts, etc.; the foundry with all necessary engine castings and propellers, and the boiler shops with Scotch boilers, stacks, uptakes and tanks.

The 3,500-ton freighters built were of Ferris design, 276 feet 6 inches long overall, 42 feet beam, 24 feet molded depth, powered by an 18-inch by 30-inch by 51.7-inch by 36-inch stroke triple-expansion engine of 1,200 indicated horsepower. These engines were supplied with steam at 190 pounds per square inch pressure by two 12-foot 6-inch marine Scotch boilers.

Mine Sweepers and Tugs

The mine sweepers were built according to Navy specifications and were 187 feet 10 inches long overall, 35 feet 4¾ inches beam, 17 feet 11½ inches molded depth, powered with triple-expansion engines, 19 inches by 29 inches by 46 inches, with 30-inch stroke, developing 1,400 indicated horsepower and supplied with steam at 200 pounds per square inch by two Babcock & Wilcox boilers.

At present the Navy tugs under construction are utilizing practically the entire capacity of the yard. Four of them are on the ways now and two in the water being fitted. The first keel was laid in January, 1919, and it is expected that they will all be completed within the year. Specifications for these tugs state that they shall be of the following dimensions:

Length overall	156 feet 8 inches
Length between perpendiculars	149 feet 3¾ inches
Molded beam	30 feet
Molded depth	17 feet 6 inches
Mean draft	14 feet 7 inches
Full load displacement	1,000 tons
Water capacity	12.75 tons
Reserve feed water	17.5 tons
Fuel oil	260 tons
Speed at 1,000 tons displacement	13 knots

They are to be of the single-deck, single-screw type designed for towing at sea and for mine sweepers, the transverse system of framing being used. Quarters for the officers and crew, as well as the stores, are in a raised steel deckhouse amidships.

Triple-expansion engines, 21 inches by 33½ inches by 55½ inches by 42 inches stroke, developing 1,600 horsepower, are being built at Port Richmond for the tugs. Two Scotch boilers, 13 feet 5⅜ inches diameter and 11 feet 2 inches long, are to be installed and will supply steam at 185 pounds per square inch pressure.

Variety of Work Turned Out

Several rather interesting ships have been built by this corporation. Among these is the *War Captain,* a 3,500-ton Ferris-type freighter, which was the first steel ship ever built for Great Britain in the United States. When it was necessary to have a replica of the historic *Clermont* for the Hudson-Fulton celebration, it was left to the Staten Island Company to reproduce the ship from existing models and drawings. In the field of racing motor boats, the *Dixie IV,* built here, held the world's speed record until very recently. A great variety of design has been turned out at the plant, including tugs, barges, ferry boats, racing craft, steam yachts, mine sweepers, freighters and lighthouse tenders and hospital ships.

Housing and Transportation of Workmen

During the war, special arrangements were necessary to transport, house and look after the welfare of the 3,500 men employed by the company. At the beginning of the war no special means for handling men existed, so that the majority of the workers had to be carried back and forth from Staten Island to New York and the Jersey shore in special boats chartered for the purpose. Motor trucks, special cars and trains were run to help relieve congestion, and as rapidly as possible plans were completed for building houses on land not far from the plant.

The personal welfare and entertainment of the men in the yard has been given particular attention. To this end a Y. M. C. A. hut, similar to those in the Army camps, was constructed during the war. It has been used continuously for medical clinics, lectures on timely subjects, athletics and recreation of various sorts.

With its varied activities of ship construction and repair, boiler construction and stack work, reciprocating, steering and auxiliary engines, foundry work and repairs in connection with all of them, it is felt by the officers of the company that the normal operation of the various plants would not be materially affected by the uncertain conditions existing in the shipbuilding industry at present.

Cracked Cylinder Head Repaired by Welding

Six weeks' time and a substantial sum of money were saved in the repair of a cracked cylinder head of the main engine of the steamboat *Highlander,* operated by McAllister Brothers, New York, by welding the broken parts with electrical apparatus. The cylinder was of cast iron, 72 inches diameter, with walls 2 to 2½ inches thick. The bottom head of the cylinder became badly cracked and broken and the owners had figured on replacing it with a new head, but the time and expense required to have a new head cast were saved by welding the head both inside and out, making it practically as good as new. The job was completed in four working days by the Wilson Welder & Metals Company, New York.



Welded Cylinder Head on Steamboat *Highlander*

Pioneer Ships in American Ocean Trade

BY F. B. C. BRADLEE

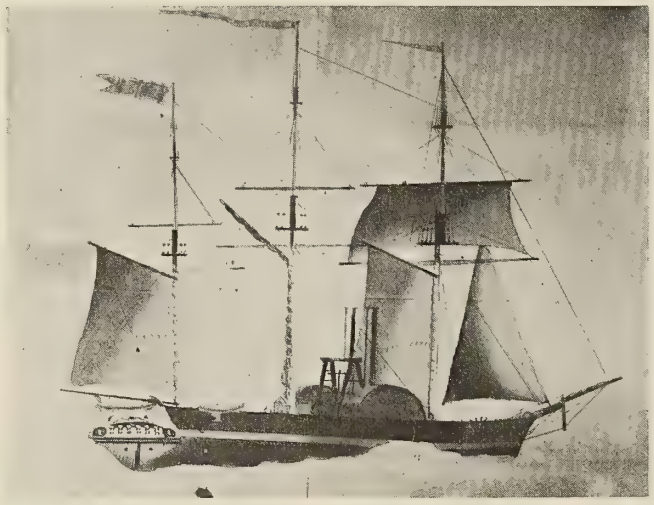
The transatlantic air voyages of the NC-4 and the R-34, recently completed, represent pioneering in the air which is comparable to the hazardous ocean trips of the first steamboats. In a hundred years the United States hydroplane and the English rigid dirigible, now exemplifying the highest skill in air craft building, will be antiquated; and yet they will still stand for an epoch in this new field. From an evolutionary viewpoint, the steamboat Robert Fulton and the one-time huge frigate Great Republic have a similar interest.

BY some people the *Robert Fulton* is considered the first ocean-going steam vessel, since she was propelled exclusively by her steam engine, while the far-famed *Savannah* used her engine only as an auxiliary, holding her paddles on deck in rough weather. In this sense the *Robert Fulton* may be considered the forerunner of the *Leviathan,* or any of our newest vessels.

This 750-ton vessel was built for Southern coastwise service by Henry Eckford, New York, in 1819 for David Dunham & Company. The hull was 158 feet long, 33 feet beam and 15 feet depth of hold. Her engine, known as the "cross-head" or "square" type, built by the Allaire Works, New York, had a 44-inch cylinder with 5-foot stroke. Two copper boilers were installed forward of the engines.

On April 20, 1820, the vessel left New York on her first voyage and plied regularly until 1825, when, owing to indifferent financial results, she was sold to the Brazilian Government and the engine taken out.

The *Salem* (Mass.) *Gazette* for May 30, 1820, gives the following quaint account of the vessel's first trip:



Robert Fulton, Built in 1820

> This elegant ship having arrived at Havana, permission was solicited from the authorities of the Island to enter free of port charges, which was promptly and honorably granted . . . she was visited by all the dignitaries of the place. . . . The *Robert Fulton* experienced heavy, boisterous weather, head winds and high seas most of the passage.
>
> She was able to work her engine the whole distance except some little time in which they were repairing the buckets of one of the wheels. . . . The ship proceeded to N. Orleans on the 10th instant.

On this route the time of the *Robert Fulton* averaged 4 days from New York to Charleston, 4 days from Charleston to Havana, and 3 days from Havana to New Orleans.

Other Coastwise Steamers of the Period

In 1837 the Southern Steam Packet Company, owned by Charles Morgan and others, inaugurated a coastwise service between New York and Charleston, S. C. The *Home,* the *Columbia,* the *New York* and the *Neptune* (200 feet long) were used on this line. These boats, with a capacity of about 550 tons, were not steamships in the usual sense of the term, but resembled the Long Island Sound steamboats, except that they had masts and sails and their guards did not extend so far forward and aft of the paddle wheels. The *Home* was wrecked on Cape Hatteras with the loss of nearly 100 lives on October 9, 1837. The other vessels ran for two or three years, and then in the summer months only, and were finally withdrawn from service because they could not stand up under the shocks and strains of the heavy weather.

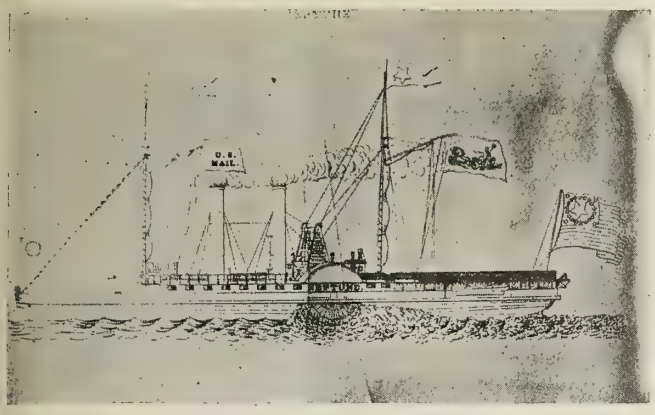
Another type of construction is shown in the *St. Louis,* a 615-ton side-wheel steamer, 191 feet long, which was built at Perrysburg, Ohio, in 1844 for service on the Great Lakes. With few railroads running west of Buffalo at that time, most of the travel to and from the West was by this route.

On June 3, 1845, in Lake Huron, the engine of the *St. Louis* was badly damaged when the cross-head gave way. She was bound from Buffalo to Chicago and Milwaukee with over 300 passengers on board. Luckily the brig *Robert Hunter* came along and towed the vessel into the nearest port. The steamer was totally wrecked in Lake Erie in 1852.

In the following year is recorded the completion of the largest full-rigged ship ever built in the United States—the *Great Republic*—which was launched on October 4, 1853. This ship was built by Donald McKay at his new shipyard located at the foot of Border street, East Boston, Mass. Until the coming of the *Great Eastern* in 1860, the *Great Republic* and the steamship *Adriatic* of the Collins line, also American-built, were the largest vessels in the world.

As originally built, she was 4,555 tons register, 355 feet long, 53 feet beam and 38 feet depth of hold. It was more than 200 feet from the deck to the main truck, with yards in proportion. The vessel was fitted with four masts. The spanker mast was 110 feet long and fore and aft rigged. The hull was constructed of oak and pine. As seen from the shore the ship was not particularly different from ordinary clippers, except in length and the great sheer forward from the fore chains to the figurehead. But once on board the visitor was struck with the enormous breadth of beam.

On completion, the *Great Republic,* under command of Captain Lauchlan McKay, was sent to New York to load grain for England. On the night of December 26-27, 1853, when nearly ready to sail, a fire broke out in a building on Front street, near where the *Great Republic*



Coastwise Steamer *Neptune*, Built in 1837



Lake Vessel *St. Louis*

lay, and the high wind blew the sparks into the rigging of the vessel, which soon caught.

While the fire was yet aloft, Donald McKay, who was on the scene, offered $1,000 to any man who would go aloft and cut away the burning rigging, spars and sails. No one volunteered to take the risk. The masts were then cut away to save the hull, but the fire spread to the ship herself and she was scuttled. Eventually she was sold to A. A. Low & Brother, of New York, and rebuilt by Sneeden & Whitlock, of Greenport, L. I.

The Great Republic Rebuilt

During the process of reconstruction the *Great Republic* was greatly changed; the spar deck was left off altogether and the masts and sail plan greatly cut down for the sake of economy in handling. By this process her tonnage was reduced to 3,357.

On February 21, 1855, she finally sailed from New York for London on her first voyage, commanded by Captain Joseph Limeburner, who was also part owner. She was off the Scilly Islands 13 days after leaving New York, but it took her three days longer to beat up the English Channel against an east wind. Owing to the vessel's beam and draft (25 feet loaded) the London docks could not accommodate her and she was obliged to lie out in the Long Reach, discharging her cargo into lighters.

The ship was employed as a transport during the Crimean War and in the same capacity by the United States Government during the Civil War. During the intervening period the *Great Republic* made several voyages between New York and San Francisco, one in 1857 of 92 days, or within three days of the record. Her best day's run with a fair wind and all plain and studding sails set is said to have been 419 miles.

There has always been much discussion concerning the *Great Republic's* spanker or fourth mast, some people going as far as to say that when the ship was rebuilt after the fire it was left out so that she really never went to sea with four masts. An old and rare photograph reproduced in this article proves conclusively that this was not the



Four-Masted Ship *Great Republic*, the Largest Vessel in Her Time

case, since the name appears clearly on the nameboard in the shadow of the spanker mast. However, when Captain Luther was a member of her crew in 1862 she then had only three masts, so the spanker mast must have been removed some time between 1855 and that date.

About 1864 or '65, Captain Hatfield, of Yarmouth, N. S., bought the *Great Republic* for himself and brothers. She was loaded with lumber at St. John, N. B., for Liverpool. Here she was sold to the Merchants' Trading Company of that city, and as the *Denmark* was employed in the South American trade until she was abandoned off Bermuda in 1872 with 16 feet of water in her hold. Thus was the end of a vessel as famous in her day as the *Aquitania* is in ours.

A Possible Use for the Shipping Board's Wooden Ships

IT seems to be established that many of the wooden ships built for the Emergency Fleet Corporation are of little, if any, value. As evidence bearing on this point we have the large number laying idle, and the constant recalking and general overhauling that is going on at repair plants. This last is very strong evidence when we consider that all of the vessels are less than two years old. The writer has personal knowledge of two vessels, each of which was recalked twice in a period of less than two months, once during her first voyage and once immediately thereafter. Another vessel was very lucky to be able to end her first voyage in a dry dock instead of on the bottom of the Atlantic.

From numerous instances like the above, it must be concluded that these wooden vessels will not stand engine vibration and something drastic must be done to save any part of the enormous investment now tied up in them. Some are undoubtedly worthless, but a large number are good enough to be altered into sailing vessels, either square or schooner rigged. Wooden schooners have always compared favorably, as an investment, with other kinds of property, many considerable fortunes having been made out of such vessels in the coasting trade.

Let us take for an example the 3,500-ton Ferris ship, having an overall length of about 280 feet. Rigged as a five-masted schooner, this vessel would show a reasonably well-balanced sail plan. The deck framing with continuous girders at the hatch sides would facilitate splicing deck beams to take care of the necessary shifting of hatches. It would be necessary to remove the amidships deck erections. A pump well would have to be provided in the waist, with a donkey boiler in the 'tween decks or in a small house. The last would probably be preferable and is more common. It would be necessary to remove the shaft tunnel in order to gain cargo space. Filling the propeller aperture and the stern tube would be necessary. The windlass should be lowered one deck to give a clear space for handling the head sails. This last change would necessitate lengthening the forecastle to obtain enough crew space. It might be found desirable to build a false clipper bow. That, however, would be largely a matter of looks. Building a house aft for the helmsman would be in accordance with good practice. A hand steerer would be good enough, but utilizing the present steam gear seems more satisfactory.

The present machinery equipment would provide all the pumps and winches needed, and, with care, almost all the additional woodwork could be built of material removed from other parts of the vessel. Practically the only new material needed would be a donkey boiler, masts, spars, rigging, sails and some heavy timber in the decks. The weight saved by the omission of the propelling machinery and the removal of the bridge erection would give a cargo-carrying capacity of about 4,000 tons, as against 3,000 tons for the ship as at present built.

In the above no attempt has been made to go into details, as these vessels, even when built from the same design, have many minor differences. Furthermore, the ports of call and the cargo to be carried would have some effect on arrangements and equipment. This makes any real estimate of the cost impossible, but, roughly speaking, the value of the machinery should nearly pay the bill. This presupposes finding a customer, which seems easy at the present time.

Of course, nobody could afford to pay the price at which the vessels are held by the Shipping Board, but it may be decided that selling a vessel for one-half her cost is more profitable than allowing her to rot.

To the man who buys one of these vessels at a price which, while high, does not include the cost of soldiering and inefficiency, her conversion, as outlined, offers a profitable investment. The proposition should also appeal to any operator who has such a ship on his hands, piling up repair bills, as he could surely reduce his losses and have a fair chance of making some profit.

A SHIPBUILDER.

Pacific Coast Shipowners Propose a Merchant Marine Policy

THE Shipowners' Association of the Pacific Coast, at a special meeting of the board of directors, held on July 3, adopted the following resolution: Resolved, That the policy set forth below is endorsed by this association as the merchant marine policy that should be adopted by the Government of the United States of America:

1. Shipyards should be released promptly from government supervision and permitted to accept any orders obtainable, either foreign or domestic.

2. The Shipping Board should cease building merchant ships when present contracts are completed.

3. The Shipping Board should sell all of their wooden ships to either Americans or foreigners at the best price obtainable.

4. The Shipping Board should offer their steel ships for sale to American citizens at the world's market price, giving due consideration to the competitive conditions. The great number of Shipping Board boats should not be dumped on the market at one time and the price should not be cut or allowed to fall below the building prices of foreign yards.

5. In the meantime, pending sale of vessels, they should be chartered to American citizens at market charter rates obtainable in the different trades, thus making it possible for charterers to use American tonnage on equal charter rates with foreign tonnage.

6. Entire freedom of action should be extended to private owners and charterers in choosing routes and fixing rates of freight and passage in competition with foreign tonnage and supply and demand upon particular routes.

7. Provision should be made so that shipowners would have assurance from the government that it would not itself operate other tonnage for its own account on same routes on which private owners or charterers are operating adequate service to take care of the requirements of the trade.

8. The present operator's and manager's plan should be continued upon unremunerative routes or upon new

routes desirable for extension of foreign trade until such time as those routes build up to the point where private owners and operators are willing to buy or charter American vessels for that service.

9. All coastwise trade should be restricted to American-owned and American-built vessels.

10. American steamship companies should be required to obtain a charter from the Federal Government, which shall exercise close supervision over their capitalization, stock issues and bonded indebtedness. A statute should be enacted revising the mortgage law so as to constitute a mortgage the first lien on the vessel, subject only to liens for salvages, general average and the wages of seamen, thus making vessel mortgages attractive to investors.

11. The compensation for carrying mail in American bottoms should be increased in order to encourage the establishment of mail-carrying lines, such compensation to be adapted to speeds economically practicable in the various trades.

12. Fuel depots, both oil and coal, should be established upon the various trade routes, such depots to be owned or controlled by American interests.

13. All jurisdiction of municipal, state and territorial control over vessels in foreign trade should be eliminated.

14. The Shipping Board recruiting service should be continued on a basis which will assure shipowners an adequate supply of officers and seamen for the future development of the merchant marine.

15. Carriage of cadets or apprentices, both in the engine room and on deck, on all vessels, government or private, in foreign trade should be compulsory and graduated wages should be fixed.

16. The length of service required to obtain an able seaman's certificate should be reduced and all applicants should be required to pass an examination before receiving certificates.

17. A naval reserve should be created, whereby the navy will pay a graduated retainer to all officers and men on deck or in the engine room.

18. Measurement for tonnage should be revised to correspond with British rules, in order to equalize charges based upon tonnage throughout the world.

19. United States steamboat inspection rules for boilers, machinery and hulls, also for deck and life-saving equipment, should be revised along the same lines of British inspection rules.

20. United States coasting laws should be extended to all American possessions.

Work of American Bureau of Shipping Commended by Edward N. Hurley

ONE of the last official acts of Edward N. Hurley before retiring as chairman of the United States Shipping Board was the writing of a letter commending the work done by the American Bureau of Shipping, in which he referred to the development of this bureau as extraordinary. "One of the greatest needs of the future," said Mr. Hurley, "for the proper maintenance and development of an American merchant marine is a strong organization operating on the lines of your bureau."

The text of the letter follows:

Mr. Stevenson Taylor, President,
American Bureau of Shipping,
New York.

Dear Mr. Taylor:

Your letter of July 25 outlining the growth and development of the American Bureau of Shipping during the trying period of the last two years, and also giving expression to your opinion and ideas of the needs of the future, is to my mind a splendid statement.

The data you give are interesting and illuminating, and it would be of very great benefit to have the facts in relation to your organization, its work, growth and development, and its prospects more generally disseminated, not alone among shipping men, where the problem is understood, but throughout the country. It is doubtful whether the public generally appreciate how very important an organization such as yours is to the maintenance and operation of shipping, but it is needless for me to say to you that it is one of the most necessary factors in the successful operation of shipping.

The development made by your bureau is extraordinary, both in personnel and in the character of the work done, and it is beyond question that one of the greatest needs of the future for the proper maintenance and development of an American merchant marine is a strong organization operating on the lines of your bureau and developed to meet the needs as outlined in your letter.

In conclusion, I feel that I am warranted in saying that you will have the sympathetic support of the Shipping Board toward the end of developing your organization as you have outlined the plans in your letter.

Very truly yours,
Edward N. Hurley,
Chairman.

Mr. Taylor, in his letter to Mr. Hurley, gave the following figures from the records of ships classed by the American Bureau of Shipping since its recent organization:

Year	Wood	Steel	Composite	Concrete	Total Gross Tons
1916	164	30			216,935
1917	189	34			259,907
1918	102	101	1	12	526,483
1919 (6 months)	111	184			1,045,314
German and Aux.	1	53			302,879
United States Navy	0	36			28,800
	567	447	1	12	2,380,318

Total ships, 1,027.

"When the United States entered into the great war," wrote Mr. Taylor, "and the Shipping Board started the building of ships, shipyards and facilities connected therewith, this Bureau had materially increased its staff and resources.

"On May 10, 1918, it was ordered by the Shipping Board that of all contracts after that date for steel ships there should be 75 percent passed by this Bureau and 25 percent by the British Lloyds Registry.

"At the time of the signing of the armistice we had received about 70 percent, but the cancellations following the armistice have reduced our proportion of steel ships to 62 percent, a situation that could not, in our opinion, have been avoided. We feel, however, that the time has come when every American support possible should be given to our American classification society, particularly the full and undivided support of the United States Government."

Expressing the opinion that "an American merchant marine can be truly American only when every element that enters into it is American," Mr. Taylor points out that the American Bureau of Shipping has ample facilities and equipment for the survey and classification of all ships built in the United States. "We believe," he said, "that the time is now at hand when the Shipping Board should not permit vessels built under its direction to be classed by a foreign society. We appreciate your efforts as chairman of the Shipping Board in strengthening and upbuilding the American Bureau of Shipping, and we have every confidence that the Shipping Board will now adopt the policy of building all of its future ships under the classification of this society, to the end that this American classification society may be able entirely to fulfill its important function in the development of a truly American merchant marine."

Shall We Build Our Marine Terminals for the Future or for the Past?

BY JAMES A. SHEPARD*

MANY of the seaport cities of the United States and Canada have either in process of building or projected important extensions to their marine terminal facilities. A recent estimate in the columns of a well-informed publication devoted to terminal engineering places the aggregate cost of these proposed improvements in excess of $100,000,000 (£20,500,000).

That the completion of these enterprises will have an important bearing not only upon the volume of water-borne commerce of these cities, but also upon the cost of handling and consequently the ultimate cost of many necessities, admits of no question. Potentially, the improvement of these important facilities for transportation represents one of the great forces on which we must depend to stay the rising tide of living costs.

Improved Terminals Generally Approved

The people of the country generally, realizing their dependence upon higher efficiency in transportation and also the necessity for the relief which it may bring to them, have generously voted or approved, as the case may be, the large expenditure already authorized and will continue to favor similar expenditures so far as needed. But they are not in a mood to add to their present burden of high living costs and taxation, except for facilities producing such pronounced improvement over present conditions as only the most serious and concentrated efforts of the engineering profession in wisely planning and equipping these terminals can accomplish.

With our present extreme costs for every kind of labor, and with no prospect for the future, except a more acute stage of the difficulty, but one resource remains: we must requisition at once every mechanical expedient which will enable us to apply our high-priced labor more scientifically and thus produce for each dollar expended as much or more than was produced under pre-war conditions.

Responsibility Rests on Engineers

Upon every member of the engineering profession, no matter which of its various branches he practices, rests an important responsibility. The farm, factory, mill, mine and means of transportation must utilize through mechanical means the forces of nature, which are still relatively cheap for every possible process formerly performed manually, because human muscle has become unable to perform the amount of work required by modern conditions and unwilling to perform in a toilsome manner work for which mechanical power and mechanical appliances are far better suited, as well as more economical.

The time is not opportune for an extended study of the causes which have contributed toward a situation in which certain features of transportation are highly efficient while others are performed by rudimentary methods. The fact is, however, so generally recognized as to justify no argument or consideration except that necessary in the application of a remedy.

The annual charge which must be and therefore is borne as a part of present living costs because of the inefficient methods in certain processes of transportation, while generally comprehended, is vastly underestimated.

We are passing through a process in transportation similar to that heretofore encountered in industrial processes; for years the actual cost for manually handling the product through the factory was grossly underestimated because it was accounted at the bare cost of the labor expended, no account being taken of the incidental costs occasioned by slow turnover, restricted production and the whole long train of incidental expenses now directly traceable to the inefficient methods of handling formerly employed.

Economic Value of Mechanical Handling a Matter of History

Industrially the enormous economies effected by mechanical handling are now a matter of history and the money value of the process has been proved by countless balance sheets. It only remains to apply the lessons learned under the roof of the factory to the railroad or marine terminal; the problems are identical. The results obtainable by identical treatment cannot successfully be called into question when applied to transportation.

Mechanics is one of the exact sciences; mechanical operations function perfectly only when all of the parts of a given mechanism are arranged to co-operate according to their own fundamental laws, hence it happens that, while the problem of mechanical handling in industry and transportation are identical economically, there are certain differences mechanically. The machine which performs perfectly a certain function in the factory may be either entirely unsuitable for a marine terminal or applicable only when greatly modified.

Market for Specialized Apparatus

We have not progressed far in identifying and prescribing these mechanical modifications because there has not been heretofore the necessary incentive for active study of the situation, and those who were potential users of mechanical handling equipment in transportation have not provided a market for the specialized apparatus required.

The gradual process by which the development of efficient methods and machinery in other divisions of industry has taken place is not applicable at this time, because we must have results in the shortest possible length of time.

Lack of opportunity for deliberate and careful decisions may lead us into some mistakes; that is perhaps inevitable, but no consequences can be so serious in their effect as failure to make adequate and positive provisions in all marine terminals which are now being constructed or projected for complete mechanical handling of cargo throughout every stage by the most rapid and efficient processes which have been devised.

Terminal Structures Must Be Adapted to Mechanical Installations

In the construction of marine terminals, as in practically all other works in which mechanical appliances are to be, or may be, employed, provision must of necessity be made in the size, strength, character and sometimes the details of the main structure for the particular type of machinery to be employed. The most difficult problem

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confronting those persons having the responsibility for the design and construction of marine terminals at this time is what provisions should be made in the terminal structures to facilitate the application, when desired, of the most efficient mechanical cargo-handling equipment.

Recognizing the necessity for an answer to such a question before rapid progress could become possible in any programme for higher efficiency in cargo handling at marine terminals, and the great loss in efficiency which must follow to the country at large should there be failure to find and apply the answer, the writer, in collaboration with several associates, has conducted an investigation of the subject extending over many months and has also canvassed the opinions of many engineers occupying a position which qualified them to judge intelligently.

It would, of course, not be proper to assume that the conclusions reached are infallible, but they are here offered in the hope and belief that they will be welcomed by many who have been unable to secure more authoritative data on the subject.

More than $100,000,000 (£20,500,000) is available for improving the marine terminals of the country; it is of vital importance to all that it should be productive of facilities which will contribute in the highest degree toward bringing the necessities of life within reach at the lowest possible cost. In whatever measure the money is spend for developments which fail to answer to the present need it will have been misspent; instead of becoming an asset, it falls among our already long list of liabilities.

Features Which Are Considered Essential and Should Therefore Be Incorporated in the Design and Construction of All Marine Terminals Intended for General Cargo, in Order to Facilitate the Installation of Cargo-Handling Machinery

Cargo as handled at marine terminals is divisible into four general classifications, namely:

Bulk Cargo.—Covering loose grain, coal, ores and similar materials in quantity sufficient to form an entire ship's cargo.

Bulk Cargo in Packages.—Covering grain, flour, sugar, cement and similar materials in sacks or other similar uniform packages in quantity sufficient to form an entire ship's cargo.

Heavy Cargo.—Covering steel bars, plates, pipe, fabricated structural steel, pig iron, boilers, heavy machinery and other heavy articles in considerable quantity or in units or packages of sufficient weight to justify or necessitate their handling on an open pier equipped with heavy cranes or by floating cranes.

General Cargo.—Covering all commodities not otherwise classified in bundles, boxes, barrels, sacks, bales or unpacked, the weight of individual pieces or packages not exceeding ten tons.

It is assumed that the greatest uncertainty as to method applies to the mechanical handling of general cargo, also that the greater portion of the terminal development projected is for the purpose of handling general cargo. For that reason the following comments are made, applicable to general cargo only.

Quay or Pier

With either the quay or pier type of marine terminal intended for handling general cargo, a portion of which must be received or dispatched by railroad, it is considered essential to provide two independent railroad tracks between the bulkhead and transit shed, arranged with crossovers at suitable intervals. Sub-structure construction should always provide for such tracks, whether immediately applicable or otherwise.

Handling Between Ship and Pier

For rapidity and all-around economy, the semi-portal type of jib crane, electrically operated with direct current, or one of the several modifications of this type of crane, operated independently or in connection with the ship's winches, should be provided for, whether immediately applicable or otherwise.

Sub-structure construction should, therefore, be made suitable for a gantry track rail about three feet back from the outer face of the bulkhead and for two-wheel loads on such track, in addition to all other loadings of not less than 60,000 pounds, spaced not to exceed 25 feet center to center.

The transit shed should be arranged for carrying a runway girder and track rail along its face when of two-story construction, arranged for a full clearance of at least 12 inches from the center of the rail to the face of the building and having a gage with the gantry rail along the bulkhead, measured horizontally, of not less than 26 feet. Provision should be made for two-wheel loads on such track, in addition to all other loadings, of not less than 35,000 pounds and spaced not over 18 feet center to center.

When the transit shed is of one-story construction the runway may be placed on top of the building column, the total horizontal distance from the face of the transit shed to the bulkhead being maintained the same as for two-story shed.

Construction of Transit Shed

The clear height of the transit shed should not be less than 24 feet, within which height and bounded by the inner face of the building columns there should be no knee braces, leader pipes, sprinkler pipes, projecting doors or door-operating mechanism, so as to permit the necessary clear room for the installation of some one of the various types of traveling cranes available for handling cargo within the building.

The carrying capacity of columns should be made sufficient, in addition to all other loads, for two-wheel loads along each outer row of columns and four-wheel loads along each row of inner columns of at least 13,000 pounds each, spaced not over 12 feet apart.

It is considered preferable to employ two rows of interior columns dividing the interior of transit shed into three bays.

No railroad tracks should in any event be placed within the transit shed, as they represent a severe interference with interior handling of cargo and are also wasteful of transit shed floor area.

Transit Shed Doors

It is considered advisable to provide doors affording a full opening between all side columns of the pier shed. A height of door openings of about 18 feet will be ample.

The practice of providing doors in alternate panels of the pier shed will affect adversely any system of mechanical unloading or handling of cargo.

The doors should be of a type which will not conflict with the crane runway or interfere with the passage of cranes either inside or outside of the pier building.

It is a simple matter to construct a transit shed so that cranes may be employed at any time their use appears to be advisable. As has been the case in industrial buildings, pier buildings will have a much greater permanent value if they present no obstacle to the employment of

machinery as the art of cargo handling advances to the point where its use is considered essential.

It is thought that cargo masts will prove to be of little or no value in any comprehensive scheme of mechanical cargo handling and that with the development of the art they will fall into complete disuse.

Duplication of Mechanical Units

It will be well to bear in mind the fact that the foreign commerce of neither the United States nor Canada is fully developed. As a consequence, certain ports which specialize in certain classes of cargo may within a few years experience a decided change in the character of cargo which must be handled. The fact that a certain type of machinery is not now necessary presents no assurance that it will not within a few years be required. A wide variety in the character of the cargo to be handled will demand variety in the handling equipment of many piers, in order that specialized and consequently efficient equipment may always be available when needed.

When the various sources of economy effected by mechanical handling of general cargo receive full consideration there will be no room for doubt that mechanical equipment, even if only used at comparatively long intervals, is more efficient than any alternative. The ax was doubtless the original wood-working implement and was adequate for every operation performed by the original wood workman, from felling the tree to splitting, shaping, smoothing, cutting to length, etc. With the advent of the saw and plane and all of the other various modern refinements in wood working, it became necessary (and efficient) to select for use from the various tools in the workman's kit such as will be immediately suitable, the remainder meanwhile lying for the time unused.

We are in the "ax" stage in handling general cargo. It is to be hoped that as we progress complete reconstruction of our harbor structures will not become necessary before we can use the other tools which must finally be added to the "kit."

Broken Web of Six-Ton Crank Shaft Repaired by Welding

AN unusual welding repair job, which required high engineering ability and skill of a high order to handle successfully, was that of a six-ton crank shaft broken through the web as shown by Fig. 1.

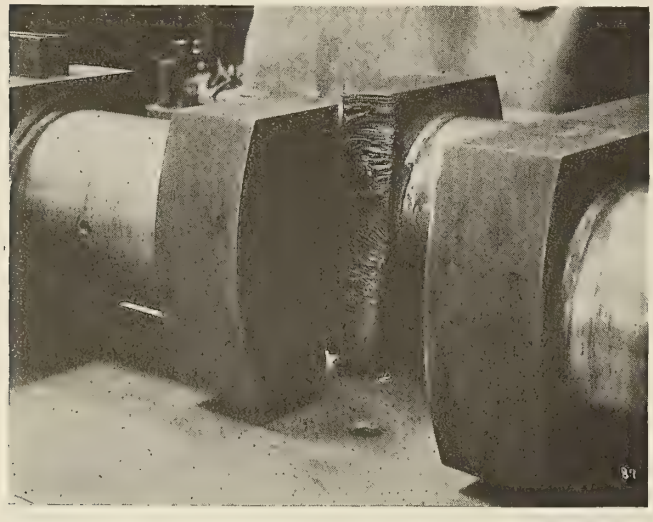


Fig. 1.—The Broken Web

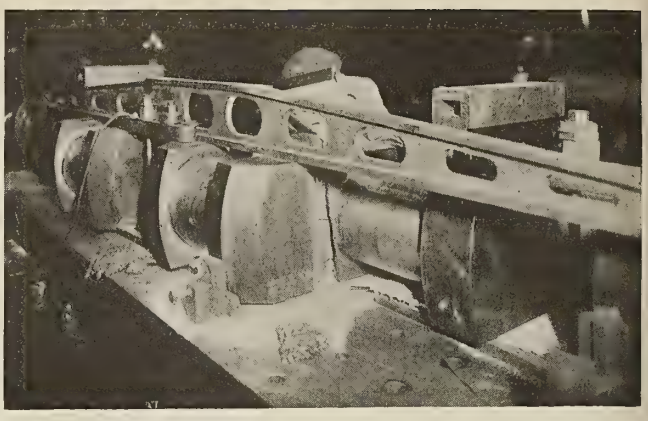


Fig. 2.—Method of Lining Up the Shaft

This shaft was part of the equipment of the Houston Ice & Brewing Company, Houston, Tex., but as repairs could not be made in that section the broken shaft was shipped to the Jersey City, N. J., plant of the Vulcan Iron Works, where it was repaired by welding by the Wilson Welding Repair Company, using a plastic arc outfit.

The greatest difficulty was insuring proper alinement of the shaft at the conclusion of the work. The shaft was clamped to the table and lined up as shown in Fig. 2. The welding proceeded after the metal at the break had been chipped out to insure a clean surface for the added welding metal to fuse with.

The job as finished is shown in Fig. 3. When the welding was finished the shaft was tested in a large lathe and found to be entirely true from end to end.

Motorship Mount Baker

THE Globe Line, 39 Broadway, New York, which operates steamship lines from New York, Philadelphia, Norfolk and San Francisco to east and west coast ports of South America, has augmented its fleet by the addition of two motorships and two motor schooners. The motorships, one of which, the *Mount Baker,* is illustrated on page 625, are sister ships, each 285 feet long, 44 feet 7½ inches extreme beam and 26 feet molded depth, built by the Supple-Ballin Shipbuilding Corporation, Portland, Ore.

The hulls are of wood built according to the new type of construction designed by F. A. Ballin, with double diagonal planking and steel plate topsides. With a gross

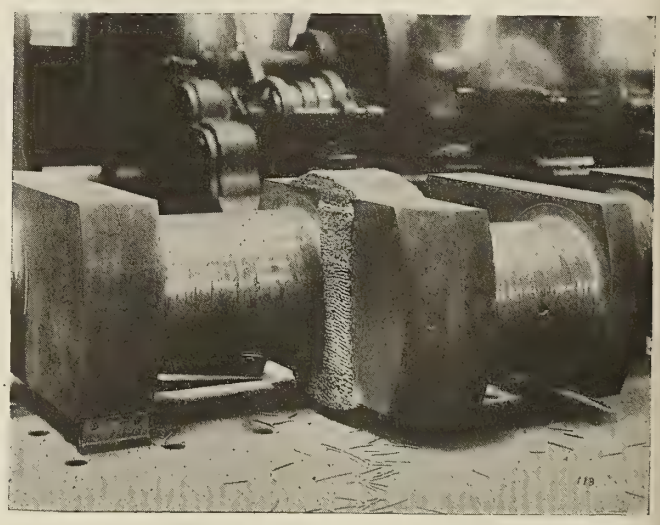
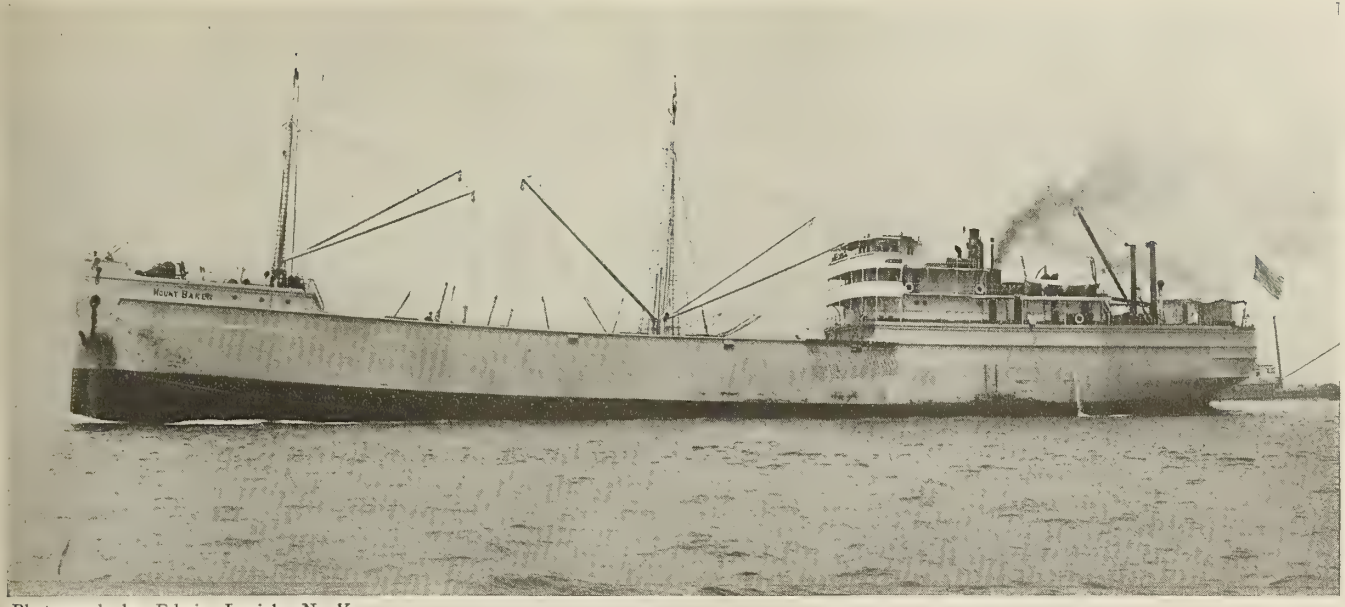


Fig. 3.—The Completed Weld



Photograph by Edwin Levick, N. Y.

Motorship *Mount Baker* Has a Deadweight Carrying Capacity of 4,600 Tons

tonnage of 2,909 and a net tonnage of 2,433, each vessel has a total deadweight carrying capacity, including fuel and stores, of about 4,600 tons. This is nearly 25 percent greater than vessels of a similar size built according to conventional designs.

The *Mount Baker* is equipped with two sets of 8-cylinder, 500-horsepower Winton Diesel-type heavy oil engines, with cylinders 12 15/16 inches diameter by 18 inches stroke. The vessel has a sufficient fuel capacity to give her a steaming radius of 15,000 miles on a fuel consumption of 30 barrels, or 4 tons, of oil per day.

For this type of machinery the engine room crew includes only four engineers, three oilers and one donkeyman. It is necessary to have only one engineer and one oiler on duty at any time. Figures recently published regarding the initial voyages of the sister ship *Mount Hood*, which is identical in every respect with the *Mount Baker*, showed that the fuel consumption was 0.0021 gallons of oil per cargo-ton mile.

No trouble from hot bearings, lubrication or weakness of parts was reported from this vessel after an 8,000-mile voyage to South America and back.



Photograph by Edwin Levick, N. Y.

M. S. *Mount Baker* on her Trial Trip; Stern View

Activities of Todd Shipyards Corporation During the War

DURING the period that the United States was at war the Todd Shipyards Corporation, in its repair yards in New York harbor, handled the tremendous total of 250,000,000 tons of shipping. A review of the corporation's war activities both on the Atlantic as well as on the Pacific is of more than ordinary interest, as its contributions to the war-winning resources of the country were of unusual value.

The first convoy of transports to carry men of the American Expeditionary Force to France included merchant vessels that had been converted into troopers by the Robins Dry Dock & Repair Company, Brooklyn. The rehabilitation of many of the big German liners that were wantonly damaged by their officers while interned here was handled by the Tietjen & Lang Dry Dock Company in Hoboken. The Tebo Yacht Basin Company in Brooklyn built for the Navy Department nine mine sweepers, fitted out for scout patrol service the yachts of millionaire patriots, and engined many vessels built by the Emergency Fleet Corporation. The product of the White Fuel Oil Engineering Corporation, a highly efficient system for the burning of fuel oil, was installed on scores of vessels, and the Quintard Iron Works, which rendered valuable service during the Spanish-American War, turned out marine engines both for the ships of our allies as well as for our own hulls.

These five companies are the New York subsidiaries of the Todd Shipyards Corporation. On the Pacific coast, at Tacoma, the Todd Dry Dock & Construction Corporation was awarded contracts for the construction of twenty-four 7,500-ton steel freighters and three scout cruisers. At Harbor Island, Seattle, the plant of Todd Dry Dock, Inc., was kept busy night and day on repair work.

The Robins plant had made a record for ship conversion in 1913, when there seemed to be a possibility of trouble with Mexico. The War Department at that time turned over three large merchant vessels to be converted into troop and animal transports. This conversion, which was almost a rebuilding, was completed on all three ships in the unprecedented time of four days and nights, and both army and navy officers expressed their astonishment that

any plant should have the organization and capacity to finish a job of these dimensions in such a short period.

It was no surprise, therefore, that the War Department should turn first to Robins when a bigger emergency arose in 1917 and send to the Erie Basin plant the first ships to be made ready to carry troops to France. The work was done in record time and the newly fitted transports sailed out of New York harbor in the first convoy. Robins converted nearly a score of vessels into transports, and when all work of this character was finished started out to make amazing records for big and unique repair work.

The demand for tonnage was never more acute than during that period, and vessels never intended for Atlantic service were sent from the Great Lakes to Erie Basin to be lengthened. The *George E. Warren, L. V. Stoddard* and the *George Hawley* were some of the vessels changed in this way. They were also converted from freighters into bulk oil carriers and oil fuel burners. The reconstruction of the *Curaca,* the repair and practically rebuilding of the torpedoed *Fred R. Kellog* and the more recent repair of the *Lord Dufferin* are Robins jobs that have interested the whole world.

There is no bigger ship in the world than the *Leviathan,* and it was appropriate that the work of transforming this marine monster into a transport should be assigned to the Tietjen & Lang plant. The same yard handled the *George Washington,* the *President Lincoln,* the *Mount Vernon,* the *Hamburg* and most of the German ships that were impressed into the country's service.

Many of these vessels had been seriously damaged by their German crews. The damage extended to practically every part of the ships, from the treating of a rope with hydrochloric acid so that it would snap immediately weight was applied, to the smashing of cast-iron cylinders, some of which were more than nine feet in diameter. Hammers and other foreign objects were found in the machinery where they would do the most damage once the engines were set in motion. Connecting rods, boiler stays and piston rods were found sawed halfway through; boilers needed renewing because they had been ruined by dry-firing. Ground glass was found in oil cups, gun-powder in the coal, metal life rafts had been punctured so that in an emergency they would be more likely to prove "death" rafts.

There were other evidences of vandalism, but, great as the damage was, it was not enough to baffle the ingenuity of the American experts called to investigate and suggest means to restore these ships to usefulness, one of whom was George J. Robinson, vice-president of the Robins Company. The damage in each case was discovered and in record time was repaired, and when sent to sea for a 48-hour test run under full power, American engineers demonstrated that their skill had triumphed over these acts of diabolical sabotage, and not only so, but these ships showed greater efficiency after their restoration than they had exhibited under German operation. Department heads at Washington computed that the repair of these ships had saved twelve months in time, enabled us to transport at least 500,000 troops to France and effected an economy estimated at $20,000,000 (£4,100,000).

The *Saratoga,* sunk while carrying troops, was salvaged, renamed *Mercy* and converted into a hospital ship. The *El Rio* and *El Dia,* renamed *Housatonic* and *Roanoke,* were converted into mine layers and sowed more mines than any other two layers. The Belgian relief steamer *Imo,* which caused the Halifax disaster in 1918, came to the Tietjen & Lank plant with a thousand holes in her hull and was made as good as new in record time. The repair of the stern of the United States destroyer *Trebble* was another record war job.

The mine sweepers built by the Tebo Company were 188 feet long, 35.5 feet beam, 18 feet deep, and provided with engines of 1,400 indicated horsepower. Eight wooden hulls of standard design for 3,500-ton steamships for the Emergency Fleet Corporation of the United States Shipping Board were engined and fitted out at this plant. Scores of yachts were transformed into scout patrol vessels, and at the present time some of them, the *Noma, Corsair, Aphrodite, Atlantic,* are being reconverted to their pre-war condition.

Self-propelled oil barges for the Navy Department are now under construction, and, bearing in mind that in 1917 Tebo's consisted of nothing more than three wharves, a storehouse, a small office and two small dry docks, it has made an enviable record.

Oil, more than any other fuel, proved its worth in the big war, and the White Fuel Oil Engineering Corporation contributed still more to the resources of the government by manufacturing and assembling oil-burning equipment.

For more than half a century the Quintard Iron Works has held a prominent place among the industries of New York, and from its origin in 1865 has made a prominent feature of the building of marine engines. During the war fourteen 1,400-indicated-horsepower engines were built for the United States Navy, as well as other engines for the Shipping Board, the Canadian Government and for shipowning corporations.

These works have pioneered in the line of improvements in marine engines, with the result that the Navy Department, which always wants the best in equipment, has been a large user of the Quintard product.

When the armistice was signed the plant of Clinton Dry Docks, Inc., in Brooklyn was almost completed, and today, with three sections of the 8,800-ton floating dock in service, has established itself as an effective ship repair yard.

In the latter part of 1916, when plants were much needed in the Puget Sound region for the building of steel vessels for the Emergency Fleet Corporation, William H. Todd visited Tacoma and selected what, to the ordinary eye, appeared to be a stretch of useless swamp. In fact, the site was under about eighteen feet of water.

A big fill was naturally required before plant construction could begin; but, once filled, the plant grew apace, and with it ships, for contracts had been taken for the construction of twenty-four steel steamers, 396 feet long, 53 feet wide and 29 feet draft loaded, of 7,500 tons capacity, for the United States Shipping Board and also three scout cruisers for the Navy Department.

The keel for the first vessel was laid in September, 1917, and a week later work was begun on the second, and from that time on the yard kept turning out fine, big steel ships to help Uncle Sam win the war. In one year the Tacoma plant launched more than 67,500 tons of shipping and was the first Pacific coast yard to launch a steel freighter in 1919.

Such, in brief, is the war record of the Todd Shipyards Corporation—a record made possible by the spirit that prevails in all the Todd plants and the inspiration given by President Todd. Through it the yards have attained a morale that has resulted in the harmonious cooperation of all departments and the unquestioned loyalty of all employees. That same morale will prove just as effective, just as valuable, now that peace has been restored, as it proved the big factor in the unsurpassed war record of the Todd Shipyards Corporation.

Problems in Labor Administration

Elimination of Financial Wastes and Losses in Production and the Promotion of the Well-Being of Workers

BY DWIGHT LOWELL HOOPINGARNER

THE human resources of any business organization require as uniform and consistent a policy as the technical problems of production or service to the public. This is true whether the product of the firm is in the form of concrete material, such as manufactured articles, or in the form of service of a more personal nature. The results secured through the thoughtful administration of the human relations are two-fold: first, elimination of financial wastes and losses in production, and, second, promotion of the well-being of the workers. In fact, the interests of both of these are ultimately identical.

It is a problem of mutual relationships. Both the organization and the individual have standards of attainment which must be met. The whole superstructure of the organization, however, rests upon the individual worker as the basic unit. If he does not work to the best advantage for all concerned, there will be a break somewhere, sooner or later. Man power has come to be the variable factor of chief importance in production, and more and more the differential in favor of any undertaking requiring a body of personnel is being measured by the degree of efficiency and contentment of its group of workers.

Labor Problems Far-Reaching

Many of the problems, moreover, are not confined within the walls of a single plant or industry. To avoid the evil effects on industry of varying standards of labor of similar nature with respect to hours, wages and other conditions of work throughout the various communities is just as necessary as to prevent wasteful practices from disturbing markets and other conditions of trade. With both, wholesome levels of operation must be maintained. Labor affects not only the extent of production, but prices and markets as well. Conditions and standards of work, in addition to involving many of the same principles of harmony that the economic factors themselves do, have a social and human significance that often surpasses their economic importance.

Illustration of how these principles are finding concrete expression to-day is found in the increasing demands pertaining to wages and hours, the various organizations of workers, the desire for industrial enfranchisement on the part of labor, and similar movements. Also, some of the more wide-awake employers, recognizing the far-reaching importance of the human factors, are anticipating the rightful desires of their workers and are co-operating with them to work out plans mutually beneficial.

Fundamental Problems Involved

What, then, are some of the fundamental problems of a specific nature that are involved?

First, there is the very real desire of workers for more of those things in life that constitute a reasonable *standard of living,* or *status.* It is a general desire—a distinctly psychological factor. It is that "something" which brings satisfaction to one individually and in the estimation of his fellows, without which he does not work or produce effectively. In time, without it he often becomes antagonistic. To him it means more than the minimum necessities of mere living, and as such furnishes the *motive power*—power for work and living. Hence, it has a decided economic bearing.

Second, there is the demand of the worker for a *greater share in the responsibility* of the enterprise. This expresses itself in two directions: first, a share in management through shop committees and collective bargaining and other mediums that give a voice in control, and, second, an opportunity for more self-expression in many cases in the work itself. In this connection, also, the worker wants to know more about the company and its work, and wants the company to appreciate his place in the organization and the conditions under which he works.

Third, the workers demand a *greater share in the product of industry.* Sometimes this demand takes the form of a request for increased wages, and sometimes it finds expression in the desire to share jointly in the profits. In either case it arises from the feeling of economic pressure, along with the practically universal desire for a better status, at times possibly not clearly defined, and from the belief that a certain portion of the product is the result of joint effort, without which no one would have this portion of the product to enjoy.

Fourth, the workers desire *improved conditions of work.* First among these is the demand for shorter hours of work. Then, too, healthy conditions of work, elimination of accidents and excessive fatigue and reasonable conditions of housing and transportation are important. In these matters, however, as in all others, the employees desire no expression of a paternalistic nature on the part of the company.

Fifth, reasonable *assurance against unemployment* is considered fundamental by the worker in order to insure him against the inability to meet the necessities of life and enjoy the other benefits which he desires.

The foregoing statements represent the minimum demands of labor which are bringing about more or less acute situations from day to day throughout industry. Failure to adjust these conditions satisfactorily is now costing millions of dollars. Without any one of these desires met the worker feels that enjoyment of the others can be of little permanent avail. In fact, it is through the others that his general desire for a better standard of living, or status, finds its expression and its assurance of realization.

Production and Finance Dependent Upon Demands of Labor

Along with the demands of the workers there must be considered the problems of production and finance which the employer must meet. These require that, in so far as practicable, maximum production be secured at minimum cost. Too often, however, this cost has been figured on the too narrow basis of the material factors alone without recognition of the ultimate identity of interests of employer and worker, with consequent loss to both. There is, then, the problem of *correlating the requirements of production and finance with the reasonable demands of labor* on the common basis of mutual interest.

It is apparent, however, that both the worker and the

employer in many cases are not in a position now to adapt themselves quickly and with the greatest benefit to these changes in conditions. It is necessary that each inform himself of the requirements and opportunities of these several factors of readjustment as they are brought about. There is also, therefore, a further and pressing problem of *education*. The worker needs to have information regarding the facts of sound business enterprise and to prepare himself to assume his share of the responsibility or control of industry effectively and to advance his standard of living appropriately. On the other hand, the employer needs to acquaint himself with the psychology of the worker, his natural feelings and desires, and the requirements for his most productive effort. Each needs to educate himself into the confidence of the other.

Industry Must Be Conducted on a Co-operative Basis

The task of meeting these demands requires the most careful thought in adjusting the organization and methods of conducting industry. Industry must be established and conducted on a *co-operative, and not a conflict, basis.* This is the most fundamental problem of all, upon a workable solution of which depends largely, in turn, the satisfactory accomplishment of the other aims. Co-operation, of course, does not always mean agreement, but it means willingness to work together.

The general administrative machinery required to effect this co-operation is of three types. The first is the *policy determining organization,* the second the purely *administrative organization,* and the third the technical producing or *working units* themselves.

Policy Determining Organization

The *first* of these finds expression in the various types of works or shop committees and collective bargaining with purely workers' organizations. Whether they be based on industrial or craft lines, however, they should be promoted in the belief of the mutuality of interest between both sides, and not with the desire to "strike the best bargain." Honest differences of opinion should be freely discussed and not condemned.

As indicated, these committee or conference units are composed of representatives of both management and workers, with the tendency developing favorably towards equal voting power. Their function is to determine matters of policy on such questions as wages, hours and other conditions of employment. Those questions that are of local significance within a given plant or industry permit of less complex machinery than those of wider importance which affect various communities or industries. Industry as a whole is now confronted with the task of determining the proper jurisdiction and methods of organization for handling these matters. It must also consider how far joint management shall extend beyond matters relating merely to employment and working conditions.

Administrative Organization

The *second* type of organization is that responsible for the administration of the policies determined by the first. It is the department of industrial relations or employment administration. It has, of course, an appropriate voice in the organization that formulates the policies.

This department is the centralized channel for promoting and assisting in handling all matters pertaining to labor relations. It requires a trained staff and specially adapted machinery, organized and equipped to deal with them. Co-ordination of effort under one head is as necessary in caring for the interest of the worker and the interest of the organization as it is in handling the material or financial end of the enterprise.

Functions of Administrative Department

Some of the more important functions which this department finds necessary to perform are: To develop sources of labor supply that will provide a sufficient number of competent employees; to direct the selecting and placing of employees in the jobs for which they are best fitted; to control questions of transfer, promotion, discharge from the plant, and other adjustments affecting the employee relationships; to administer the work on accident prevention, health and sanitation, training, housing and transportation, and the like; to advise with the department heads concerning their labor difficulties and problems and furnish them with information on labor conditions; and generally to develop within the organization plans for mutual helpfulness that will promote a spirit of genuine co-operation and understanding between the management and the workers.

In carrying out the administrative work on employment relations through a single co-ordinated department, however, care must be taken, as with the policy determining organization, to see that the department heads and foremen have adequate voice in matters pertaining to the work of their departments. In the final analysis, the function of the department of employment relations is to see that the various labor matters are satisfactorily cared for, rather than doing them entirely itself.

One of the most fundamental policies that can be established is the maintenance of an executive council or cabinet to discuss the interrelated problems of labor and production. This cabinet should be composed of executives who are in charge of the technical problems of production, the manager of labor relations, and the executive who is in charge of the problems of general control. It functions in helping to co-ordinate the various phases of labor administration with the operating departments.

Co-operative Organization Among the Workers

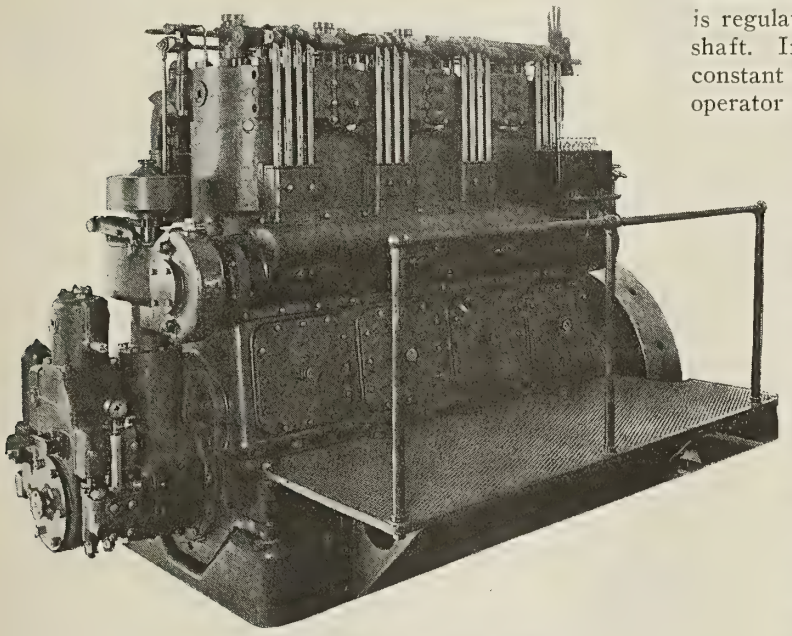
The *third* type of organization necessary to effect co-operation is that within the producing or operating units themselves. It expresses itself in improved methods of production for the workers as members of the group, and in stimulating co-operative effort in the group as such. It deals with the worker in his daily round of work, and helps to create a feeling of mutual interest between him and the management.

This programme should have as one of its outstanding features personal contact with the employees. The management should keep in touch with the needs and abilities of the employees and their working conditions. There should be a constant exchange of judgment between the department heads and the employment manager to determine the requirements, and to help keep in close contact with the working force. Sympathetic understanding of conditions, recognized in time, will often prevent lack of interest, resignation, or discharge of valuable employees. It is a problem of developing possibilities within the worker not always visible at the time of employment.

Throughout the entire programme of labor administration, emphasis must be placed on the necessity of better adapting the workers to the work, and in many cases the work to the workers, rather than the elimination of workers from employment, in the belief that this in turn not only makes specifically for increased production, but also generally for the mutual advantage of all concerned. Above all, human resources must be conserved, both economically and socially, if production and mutual well-being are to be maintained.

The Pittsburgh Marine Oil Engine

DURING the last few years much interest has been displayed by the engineers of this country in the type of high-compression oil engine originally developed in Holland by the *Brons Motorenfabrik, of Appingsdammer,* but better known in America as the Hvid type motor. So much interest has been aroused that from twelve to twenty domestic companies have taken out manufacturing licenses for marine or stationary sets, or else for both. The marine field for this engine includes power for ship's lifeboats, tugs, sailing-vessels, general-service craft, harbor launches, fishing-boats, emergency wireless-plants, and engine-room auxiliary machinery. It may be mentioned that many of the large Diesel motorships turned out by the Werkspoor Company, of Amsterdam,



Pittsburgh Heavy-Duty Oil Engine

use Brons type oil-engines for the electric-lighting equipment with considerable success, so doubtless the Pittsburgh engine will be used in American ships for the same purpose. It operates on the four-cycle principle and is made in sizes of 25 horsepower per cylinder in one-, two-, three- and four-cylinder units, both in the marine and stationary types.

Among the American manufacturers which have entered the marine field with an engine of this type is the Pittsburgh Filter & Engineering Company, with general sales offices at 280 Broadway, New York. This engine, it is claimed, combines the economy of the Diesel principle with mechanical simplicity. It is independent of any carburetor, hot-bulb or plate, spark-plug, high-pressure air-compressor, air storage tanks, fuel-pump or spray-valve. The compression is carried to approximately 500 pounds per square inch, and the motor is started from cold without pre-heating and put under full load in a few seconds. The makers state that it will burn any grade of the cheaper fuels, from kerosene (paraffin) to the heaviest of fuel-oils generally used in motorships, the same fuel serving for starting the motor.

In the design of the Pittsburgh engine, the aim has been to combine simplicity of construction with accessibility. The engine is of the enclosed type, and the designer has adhered as far as possible to the thoroughly tested practice of modern Diesel engines. Not only is the crank case enclosed, but the camshaft bearings, roller-levers and gears run in a bath of oil. The camshaft can be removed by taking off the front cover. Accessibility of the crank-pins is provided by very large openings in the crank-case. Air to the cylinders is admitted through slotted mufflers.

Starting is accomplished by means of compressed air of about 125 pounds pressure per square inch, each cylinder being provided with an air-starting valve. The starting is assisted by compression-relief valves. Starting and relief valve-rockers are mounted on eccentric shafts, and a single turn of the control-lever brings the engine from starting into the running position. This operation of the control-lever also shuts off the fuel to the cylinders during the starting period. Compressed-air for charging the starting-tanks is supplied by a compressor driven off the engine-shaft. The amount of fuel required is regulated by a suitable governor mounted on a vertical shaft. Independent from this automatic regulation of a constant engine-speed, a hand control-lever enables the operator to slow the engine down while running.

The lubricating system is complete and entirely automatic. The arrangement adopted provides for the use of two grades of lubricants for the pistons and bearings respectively. The pistons are oiled by a suitable force-feed lubricator driven off the camshaft. This lubricator has individual feeds and a float-valve for automatically keeping the lubricator filled when connected to an overhead reservoir, no attendance being required.

Main-bearings, crank and piston pins are at all times flooded by a copious stream of cool oil by a plunger pump driven off the engine-shaft. The oil is initially forced under pressure into the main-bearings, and through drilled passages in the crank-shaft into the crank-pins, thence through the drilled connecting-rod to the piston-pin. The oil after leaving the bearings is collected in the crank-pit and flows to a strainer, and from here a small plunger-pump delivers it to a suitable filter. After leaving the filter the oil passes through a cooling-coil and is used over again.

The base or bed-plate is of a rigid box-section cast integral with the crank-pit and seats for main-bearing shells. These shells are of cast-iron, lined with babbitt-metal. The main-bearings are provided with shims for adjustment. The shims are composed of layers of brass firmly held together by a metallic binder. An adjustment of 0.002 inch is made possible by this method.

Open-hearth steel is used for the crank-shaft, and it is forged from the solid; and for all smaller engines, including the four-cylinder size, is made in one piece. The six-cylinder shaft is made in two half units. It is enlarged and tapered at the end to receive the flywheel. The enlarged end also serves as coupling flange for the shaft. Cylinder frame and crank-case for engines, including the four-cylinder size are cast in one piece; for the six-cylinder unit two three-cylinder frames are bolted together. The working cylinder proper, or liner, is of plain cylindrical form, of close grain cast-iron and held in place at the head, the end only being free to expand and contract in its length.

No crossheads or guides being used, the piston is of the trunk type. It is of a close grain cast-iron ground to size. The inside of the top of the piston is provided with ribs for radiation of the heat as well as for strength. To

(*Continued on page* 640.)

Battleship Fleet Goes to the Pacific

(Photograph by Edwin Levick, New York)

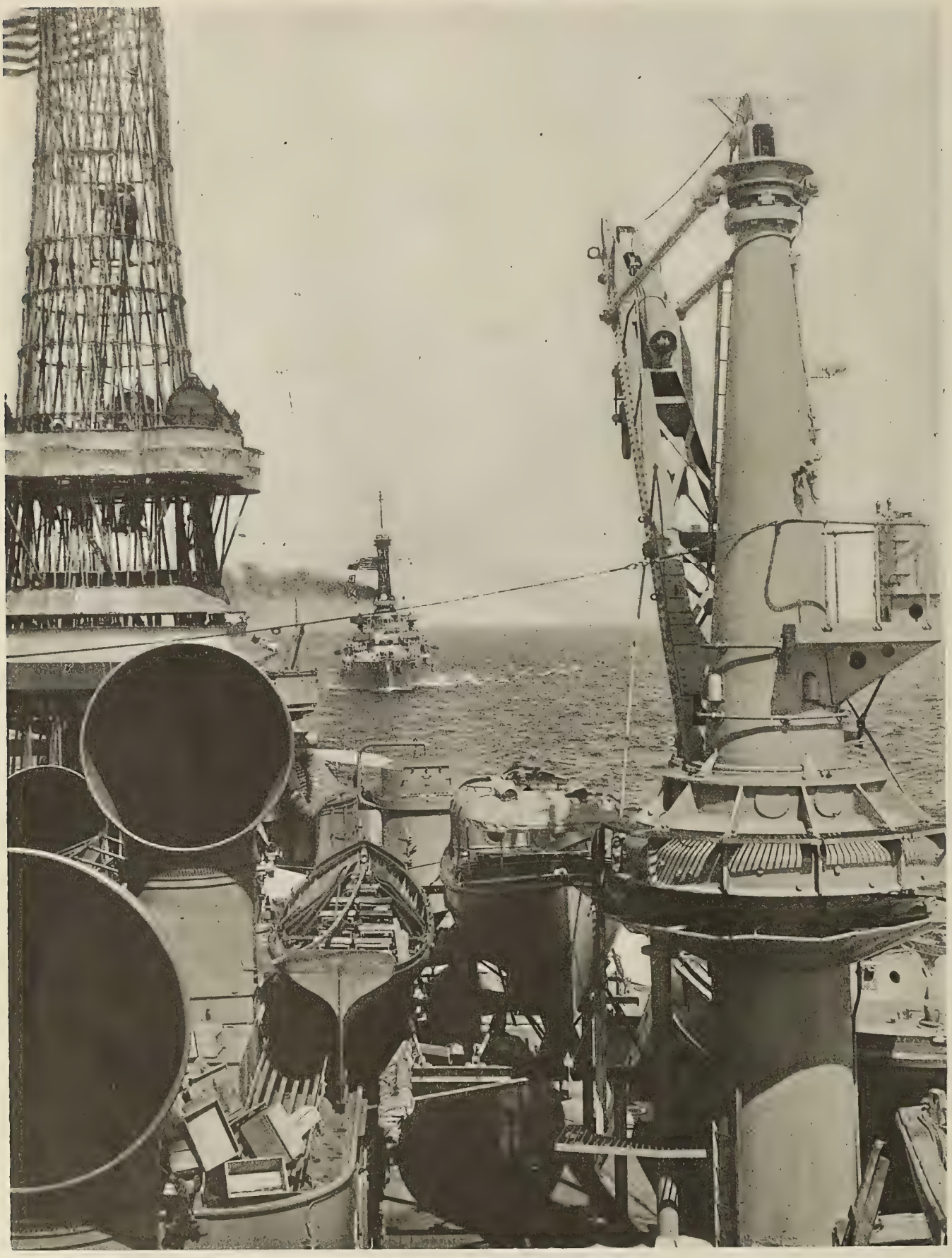
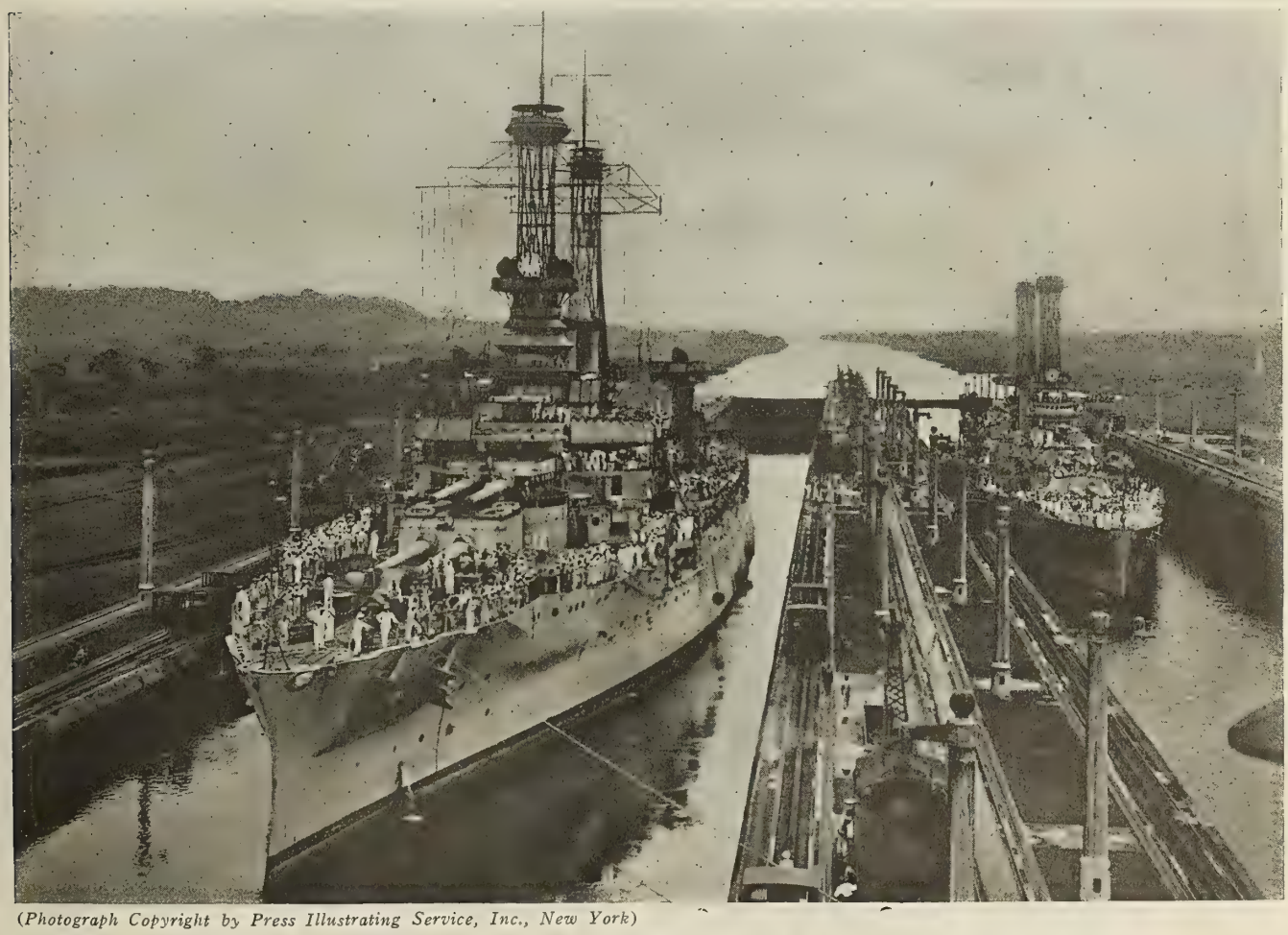


Fig. 1.—Strong Fleet of United States Battleships, with the *New Mexico* as Flagship, Leaves for the Pacific Coast via the Panama Canal



(*Photograph Copyright by Press Illustrating Service, Inc., New York*)

Fig. 2.—The *Wyoming* of Pacific Fleet Passing Through Gaillard Cut



(*Photograph Copyright by Press Illustrating Service, Inc., New York*)

Fig. 3.—Superdreadnoughts of the Pacific Fleet Going Through the Locks at the Panama Canal

Motor Trucks and the Problem of Efficient Marine Freight Terminal Operation—II

BY MERRILL C. HORINE

The use of equipment which can be quickly and easily operated is the determining factor in efficient terminal clearing. Shipments must be kept continuously on the move. In this number Mr. Horine discusses the use of the motor truck for this service, making a scientifically worked out comparison of the horse dray with motor carriers, to the great advantage of the latter, provided reasonable operating conditions are available. Under this head he also discusses the value of store-door delivery, permitting centralized control of carrying agencies and economic routing in collecting and delivering shipments.—THE EDITOR.

VENTURI, the Italian scientist, discovered, in connection with studies of air-flow, that a certain relation between the intake and outlet angles of a choke-tube produced the maximum velocity of air through the restricted throat of the tube with the minimum resistance to the flow of the fluid. His fundamental hypothesis was that for a fluid to pass through a restricted orifice without diminishing the rate of flow beyond that orifice, it must pass through at a greatly accelerated speed. The marine freight terminal problem exactly parallels this example of physical law.

Freight terminals are the place of greatest restriction of area in the path of shipments from place of origin to destination. In order not to slow down all freight movement, the terminals must be capable of passing the freight through at greater speed than the average speed at which it is carried in ships and railroad trains. To accomplish this end, swifter means than handtrucks must be used to move freight across the bulkhead. To avoid congestion of load platforms, quicker loading and unloading of vehicles and faster street conveyances are needed to effect transfers to other terminals, warehouses and local destinations.

QUICK-OPERATING EQUIPMENT DEMANDED

Unloading piers and platforms must not be used for storage, because of their limited area and the necessity of keeping a space clear for the reception of more freight.



Fig. 8.—Congestion Everywhere—Even the Slips Are Choked With Lighters and Floating Cranes Trying to Load and Unload the Steamers and Make Room for Waiting Ones to Berth. Proper Facilities Would Reduce Even This Congestion—Brooklyn, N. Y.



Fig. 9.—Typical New York Pier, Showing Goods Piled on Floor Waiting for Consignees to Call for It, Meanwhile Obstructing the Discharge of New Inbound Cargoes or Assembling of Outbound Ones

This involves immediate removal of goods from piers and platforms to warehouses where there is room for storage, sorting, classifying and efficient loading of vehicles. The movements involved must be made by mechanical means—by electric industrial trucks and tractors, by telpher, escalators and moving platforms. Motor vehicles must be used to supply faster street conveyances, and these must be of high capacity and so efficiently administered that they can maintain a high load factor.

With warehouse loading and unloading accomplished by motor trucks and standardized trucks under one ownership, the most effective devices to promote the vehicle efficiency and to speed up the handling of the goods can be installed—a situation which it is not possible to establish with a miscellaneous assortment of vehicles, averaging less than half a load apiece, calling at irregular hours.

Special Handling Devices for Pier Installation

One device of this character which has proved to be of the greatest effectiveness in several private installations is the sectional demountable body. Such a body when on the truck fulfills the usual mission of a truck body and resembles the conventional rack body in appearance. It is divided into identical sections, however, numbering from two to four, which are interchangeable and demountable from the chassis. Either an electric telpher or a battery tractor may be used to haul them considerable distances within the warehouse, singly or in trains. When detached, they form handtrucks to and from which the goods may be handled manually.

Another device is the lift van, which is quite common in Europe, although it is little used in this country. This comprises a van body, demountable and interchangeable, into which a fragile shipment may be packed at one point and shipped through to destination, even half-way around the earth, without unpacking. It forms the body of a motor truck or horse wagon, may be lifted by cranes, carried on flat cars or in box cars, or stowed in the hold of a ship.

> "If all horse transportation at our docks could be displaced by motor trucks, the number of vehicles required to carry the same daily tonnage would be one-tenth the number used at present. . . . . Why, then, do horses predominate and why are most attempts to operate trucks in terminal haulage failures? The reason is the same as the answer to the question: Why does it cost more to operate ships out of American ports than between European ports? It is because we are attempting to operate twentieth century ships, railroads and vehicles with twentieth-century volume of traffic by terminal methods designed for wooden sailing vessels, narrow-gage railroads and ox-carts."—Merrill C. Horine.

Value of Motor Trucks Under Reasonable Conditions

Today it is unnecessary to demonstrate that motor trucks, given reasonably favorable conditions under which to work, can transport freight more quickly, cheaply and in greater unit volume than horse transportation; yet we find freight terminal work practically the only line of commercial haulage in which horse transportation still predominates. If all horse transportation at our docks could be displaced by motor trucks, the number of vehicles required to carry the same daily tonnage would be one-tenth the number used at present. Everyone knows that, size for



Fig. 10.—Unloading Tobacco from a Coastwise Steamer—Brooklyn, N. Y.

size, motor trucks cost considerably more to operate than horse drays; but, since they are capable of carrying ten times the daily tonnage, the additional cost is still proportionately low when compared with the service they can render. Their operation is not ten times as expensive, and in these times we doubt if two teams can be operated on the amount which represents the daily cost of a motor truck.

Why, then, do horses predominate, and why are most attempts to operate motor trucks in terminal haulage failures? The reason is the same as the answer to the question: Why does it cost more to operate ships out of American ports than between European ports? It is because we are attempting to operate twentieth century ships, railroads and vehicles with twentieth century volume of traffic by terminal methods designed for wooden sailing vessels, narrow-gage railroads and ox-carts.

Horse Haulage vs. Motor Transportation

If it were possible suddenly to replace all of this horse haulage with motor transportation, methods at the terminals would soon shape themselves so that the latter could work efficiently. However, so long as horse transportation predominates, horse-pace methods will prevail and motor truck operation will be quixotic. Horse and motor transportation will no more mix than oil and water.

The average city dray hauls a load of 4 tons, and two trips, each representing about 4½ miles, is considered a good day's work. As the return load is usually a negligible factor, the daily tonnage delivered is about 8 tons.

If intelligently handled, motor trucks, as rented in New York on a 50-mile-per-day basis, will average a full load in each direction. With hauls of 4½ miles average length, this equals 11 loads a day easily, to do which an average speed of but 5 miles per hour is necessary in a 10-hour day. In such a day's work a truck could deliver, with return loads, 110 tons. To reduce the estimate to 80 tons per day is amply conservative and is exactly ten times the work performed by the average team.

If conditions were proper for the operation of motor trucks, it would be feasible to haul goods manufactured 100 miles from a port directly from the factory door to the pier with one loading and unloading, thereby saving many days of time, preventing the destruction of goods due to rehandling, eliminating congestion at railway terminals and switchyards, so that these might serve marine terminals more effectively and, equally important, economizing in the cost of the transfer.

As long as shippers are willing to pay for horse haulage under present conditions, the horse owners are not anxious to push matters. Owners who know their costs are charging $15 (3/6/2) a day for the service of horse

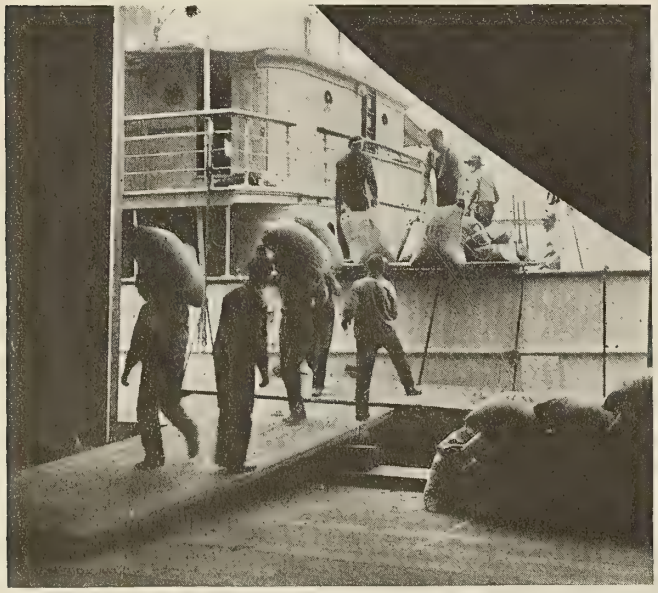


Fig. 11.—It is Methods Such as This That Impede Loading and Unloading Efficiency, Thereby Slowing Up All Transportation, Land and Water—Unloading Coffee in Brooklyn, N. Y.



Fig. 12.—A Passing Figure. Mechanical Appliances Must Replace This Slothful and Expensive Method of Interior Transportation—Coffee Warehouses, Brooklyn, N. Y.

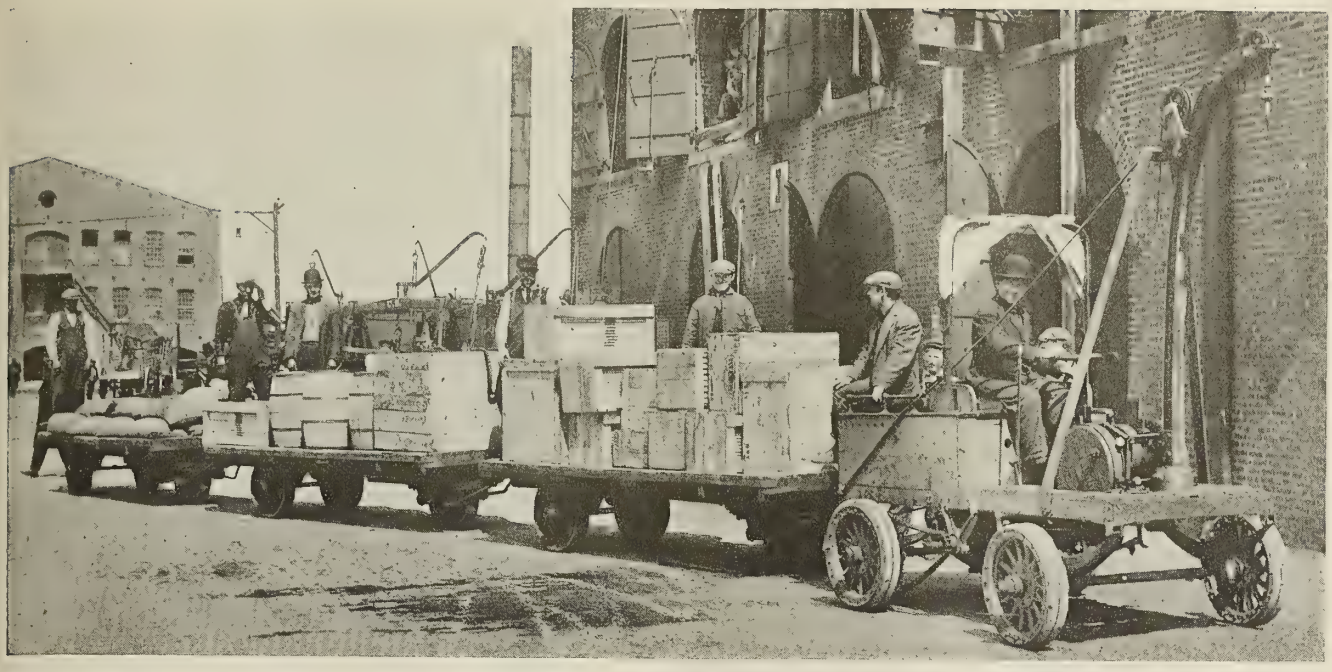


Fig. 13.—The Electric Crane Tractor as Used by Bush Terminal Is an Efficient Link Between Pier and Warehouse—Bush Terminal, Brooklyn, N. Y.

drays, or half the price at which one hires a 5-ton truck from a responsible trucking concern. Some horse owners have not made their prices keep step with rising costs and have realized their mistake too late, as witness the recent dramatic failure of one of the largest and longest established transfer concerns in New York.

In some cases a truck can do no more than a horse team, except that when the shipment is large enough it may carry more of a load on the same two trips per day. If conditions were right for the truck, however, an investment of $30 (6/5/0) in truck hire would produce five times the tonnage that $30 (6/5/0) invested in horse transportation does to-day, and would deliver the freight more quickly, which is an important consideration in the handling of perishable stuffs.

Trucks Economize Traffic Space

Such efficiency as is assumed above for the truck is entirely possible if the motor becomes predominant, because of the decrease in the number of vehicles necessary to handle the same tonnage and the economy in traffic room. This latter economy inheres not alone to the decrease in numbers, but results also from the smaller size of the vehicles in overall dimensions, their increased mobility and maneuvering ability and their greater



Fig. 14.—The Electric Industrial Tractor, Because It Is Quicker, Cheaper and More Economical of Space Than the Hand Truck, Must Come Into Use Generally—Pennsylvania Terminal, New York

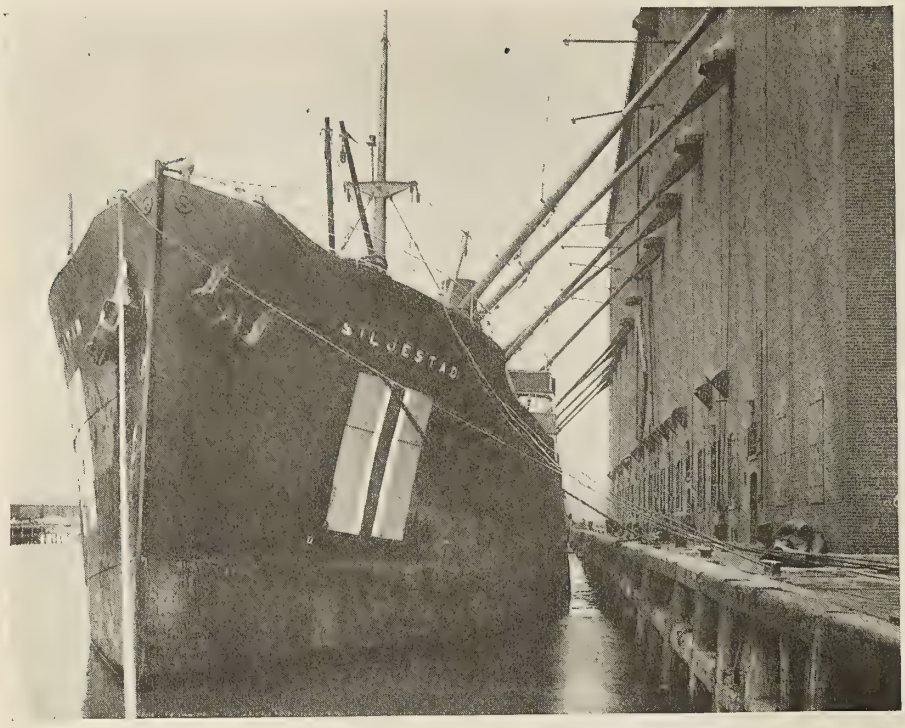


Fig. 15.—There Is No Reason Why Ships in Atlantic Trade Should Require 12 Weeks Per Round Trip. More Than Half This Time Is Spent in Port. During the Wheat Famine in Europe in 1915, This Ship Was Loaded and Cleared the Port in 24 Hours—Weehawken, N. J.

speed, which causes them to ocupy traffic space during a shorter period of time.

An ordinary 5-ton truck is, roughly, 20 by 7 feet and requires 9 feet of side clearance. A horse dray is 25 feet long, including the animals, and should have 10 feet of roadway to allow for the erratic movement of the animals. The truck occupies 180 square feet of traffic area; the horse dray and team, 250. Each truck saves 70 square feet per dray displaced, or 700 for the ten that it can supplant.

These are not newly discovered facts. They have been recognized by economists for years. It is essential that terminal improvement and organization of vehicular transportation go together. Not only would one be checkmated without the other, but it is doubtful if either is possible alone. This has been recognized by the government—which can afford to recognize things, not having competition to reckon with—as is evidenced by its own new terminal on New York bay, at the southerly end of Bush Terminal, where only motor (vehicular) transportation has been provided for.

Shortly before the close of the war it became apparent to the authorities at Washington that terminal sloth was impeding the expeditious movement of both terminal and overseas traffic, which in turn hampered us in making and transporting military supplies for our expeditionary forces. As a result, the Highways Transport Committee, at the instance of the then Director-General of Railroads, William H. McAdoo, evolved a plan calculated to relieve the situation by eliminating the free time at terminals.

The War Emergency—Store-Door Delivery

The method proposed was to institute store-door delivery, beginning with New York and possibly extending it to other ports. The plan at first contemplated a trucking pool, in which all vehicles now serving the terminals would be required to carry capacity loads from the terminals and return loads at all times. Every pier was to be under the control of a government drayage director. Owners of vehicles were to enter into agreement to place them in service for shippers and receivers of freight at large under his direction at uniform rates. These vehicles were to be assigned to the different piers daily and dispatched with full loads of inbound freight each vehicle loaded with goods for a given zone of the city. Having delivered this, each was to pick up a full load and return it to the terminal for shipment.

The freight received each day was to be delivered within 24 hours of its unloading from ships or carfloats direct to the door of the consignee, without action on his part, collection being made by the driver of the vehicle. This feature of the scheme raised an objection, as it was found to be an all but hopeless problem adequately to bond such a miscellaneous lot of drivers. It also had the disadvantage that consignees could not then inspect incoming shipments, and in cases where the goods were to go into storage a second handling was necessary, whereas under the old scheme the consignee would have it trucked directly from the terminal to the warehouse of his choosing.

The scheme later developed into a trucking pool. Only 5-ton trucks were to be used in the service, these being under contract from large concerns or associations of owners, practically establishing a trucking trust, or at least confining the business of a few large operators. As the scheme was discussed, new complications were constantly arising and added objections were raised. Quite naturally the trucking and teaming interests generally were antagonistic, with the result that with the signing of the armistice the scheme was abandoned.

Doubtless the plan was faulty and but few tears were shed over its eventual failure. It is a matter for debate, however, whether the terminal facilities, even with these faults, would not have been more efficient under the new plan than with the present indefensible practice. As one prominent team and motor truck owner expressed it, the scheme provided for close to 100 percent load efficiency as against a maximum of 25 percent now possible.

Store-Door Delivery in Baltimore

Some years ago the Baltimore & Ohio Railroad made store-door delivery in Baltimore. The service was discontinued because the Interstate Commerce Commission ruled that charges for such service could not be absorbed in the freight tariffs as they were in express rates, and it was found impracticable to make a separate charge. Under the latter ruling the company would have had to give the consignee the option of calling for his shipments with his own vehicles, which would have resulted in congestion such as can be avoided only by a monopoly of the pier or terminal by one centrally controlled fleet of trucks.

In England, store-door delivery has existed practically as long as railroading, and the rates are made to include the cost of drayage. The express companies make store-door delivery and store-door pick-ups, for which the charge is absorbed. Free delivery of mail is accepted as indispensable, and, were the public to enter the post office



Fig. 16.—Brownhoist Electric Man-Riding Trolley as Used in Wholesale Grocery Store—Los Angeles, Cal.

and ransack incoming mail bags for their letters, the confusion that would result would only be greater in proportion to the greater numbers of searchers than is the present scheme at marine freight terminals.

Free Lighterage a Direct Analogy

Experts have ascribed New York's supremacy as a port to a large extent to free lighterage, so-called, whereby freight can be lightered from any ship or wharf anywhere in the harbor to any railroad pier or designated waterfront warehouse at no charge to the shipper. This is in effect store-door delivery via water and is justification enough for the application of the same principle to land lighterage, as draying may be termed.

The volume of freight lightered about the port of New York is approximately the same as that moved by drays. The explanation of the potent effect of free lighterage on the growth of New York harbor is that it has permitted direct connection of the ship with every railroad entering the city, offering a choice of transportation facilities inland and tapping a breadth of inland territory unparalleled by any other port in the world.

If free lighterage of approximately 20 percent of the tonnage passing through New York terminals can do this, or even lighterage charged for directly, provided the service is universal, then universal, direct drayage should be able to effect an almost similar improvement in the facilities and attractions of the port of New York or any other port in proportion to its size and importance.

(To be continued.)

Hints for Electric Welders

IN notes designed for instruction in electric welding by H. L. Unland, of the General Electric Company, occur certain suggestions which are worth repeating.

When carbon electrodes are used in arc welding the average length for efficient work should be from 9 to 12 inches. Metallic electrodes of low carbon steel should be about 18 inches long. At least 15 feet of extra flexible cable should be used to allow the operator full control of the electrode through the welding process.

Doubt is often expressed as to the current required for certain types of work. In general in the case of light work where the metallic electrode is used a current not greater than 125 amperes is necessary, while heavier work will stand 225 amperes without burning the electrode. Plates of ¼-inch require 125 amperes. Heating with the carbon electrode necessitates the use of greater currents; light welding, 150 to 250 amperes; heavy welding and medium cutting, 400 to 600 amperes; very heavy work, 600 to 1,000 amperes.

Flux is not necessary to good arc welding and has a tendency to contaminate the weld if used. With the metallic electrode the work should be cut sharp—not over ⅛-inch in length. The current should be held within the limits suggested. Excessive current causes burnt or porous metal to be deposited.

In welding a seam the electrode should be moved in a circular path, advancing along the seam. The metal will adhere only to the surface actually played on by the arc, so care must be taken that the entire surface is covered.

The electrode must be connected with negative terminal, as it is difficult to maintain the arc with the polarity reversed. In starting the arc the electrode should be just touched to the arc and immediately withdrawn to the proper distance.

When welding with the carbon electrode an arc 1 to 1½ inches is the average, but in cutting it should only be ½-inch.

The eyes of the welder should be thoroughly protected by a mask from the light of the arc, or serious burns to the interior of the eye will result. No chinks or holes in the mask should be permitted, since only a brief exposure of the eye is required to bring on painful results. The inside of the mask should be kept painted dull black to prevent reflection of the light from behind.

Uniform Cost Accounting in Shipbuilding—II

Plan Adopted by the Atlantic Coast Shipbuilders' Association for Uniform Methods of Cost Accounting in Steel Shipbuilding

BY J. L. JACOBS*

For proper checking and cost finding it is essential to have adequate control over all material and supplies through a centralized stores system. Requirements for the purchase of materials should originate in the engineering or production department where the bills of materials are prepared. Purchases should be made through the purchasing department in connection with stores' requirements. Copies of purchase orders should be sent to the stores department so that receipt of materials can be checked with purchase requirements, and no stores should be issued from stock except upon written requisition.

Material and Supplies—Stores' Control

With proper centralized stores' control, the accounting of costs of material and supplies presents no particular difficulties, as each transaction is directly traceable to a specific job account or departmental use. A clear distinction is drawn between (1) general stores and (2) contract stores. Under general stores are included all stock materials and supplies which are not assigned to any definite or specific job. Under the general stores are such subsidiary stores as general supplies stores, fuel stores, paint stores, etc.

The material classification includes the main material and supply divisions which will be used by the engineering or production department, by the purchasing, stores and traffic department in connection with the preparation of bills of material, purchasing, receiving, storing, issuing, pricing, inventorying and assembling of material costs, and will serve as the basis for analyzing materials which are in work in process.

The main divisions of the materials and supplies classification are as follows:

1. Material.
2. Parts.
3. Structural Units Complete.
4. Supplies.

Each of these main divisions is defined, and detailed lists of articles are set up in the classification under each of the divisions.

The keeping of the material cost records will be of value in connection with the following:

(a) Basis for estimating and for preparing bills of material.
(b) Basis for comparing quantities of particular items going into specific product units with standards.
(c) Making sure that all materials entering into a product have been accurately charged.
(d) Computing and analyzing material charges.
(e) Ascertaining the degree of completion on any job.
(f) Checking waste or excess amounts of any particular material entering into a product unit.

Labor Classifications and Operations

The classification of positions and occupations under main groups according to the character of work and under distinctive occupational titles should be used as a basis for the preparation of payrolls and of statistics on wage charges, selection, labor turnover, accidents and other employment conditions.

The following labor classification is drawn up on the basis of general character of work. Under each class there are included the different positions and occupations which are found in the average shipyard.

The main classes of the classification are as follows:

1. Executive, Administrative and Supervisory Class.
2. Professional Class.
3. Clerical Class.
4. Supervising Producing Class.
5. Skilled Trades Class.
6. General Labor and Miscellaneous Class.

The occupations enumerated under the Skilled Trades Class correspond to those included in the decision of October 1, 1918, by the Shipbuilding Labor Adjustment Board (Macy Board). This list is subject to any subsequent rulings which have been made by the Macy Board.

Descriptions of the duties of the occupations listed are included in the "Handbook on Shipyard Occupations," published by the United States Shipping Board Emergency Fleet Corporation.

The basic units for labor costs in shipbuilding are the labor processes or operations. The distribution of labor costs according to the major labor operations will be used for purposes of cost control, estimating, comparing costs with standards and gaging the efficiency of classes of workers in the productive departments, on the various jobs and for the plant as a whole.

Some of the more important labor operations are included in the following:

1. Annealing, Hardening and Tempering.
2. Assembling.
3. Bending and Flanging.
4. Bolting.
5. Chipping and Calking.
6. Coremaking (Foundry).
7. Drilling.
8. Erecting.
9. Fabricating.
10. Fitting.
11. Laying Out and Templating.
12. Melting (Foundry).
13. Molding (Foundry).
14. Painting.
15. Planing.
16. Punching and Shearing.
17. Reaming and Countersinking.
18. Riveting—Machine.
19. Riveting—Hand.
20. Scarfing.
21. Varnishing and Polishing.
22. Welding.

Timekeeping and Cost Distribution

The value of accurate methods of reporting and recording the daily time of each employee for payroll-making and for proper distribution of labor hours and costs against production cannot be stressed too greatly. For accurate payroll-making, for proper control of labor in

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production and for estimating and comparative purposes, it is necessary to have proper timekeeping methods, the essentials of which are as follows:

(a) Proper method of recording the daily time of each employee. There should be time clocks on which each worker should register in and out time, or there should be some other method of obtaining the same results.

(b) Job or operation tickets should be turned in by each worker for the various operations performed each day. On these job tickets there should be recorded the worker's number, the production order number, the product unit number, and the time taken on each operation.

Where mechanical sorting and tabulating equipment is available, the tabulating card and the job ticket can be one and the same, the requisite information being noted on the card in writing and the punching of the cards being done later in the timekeeping office.

(c) The total time and cost, as found from the daily in and out cards, as explained in paragraph (a), should check with the total time and cost of all the operations on job tickets. This check should be obtained daily by departments.

(d) The job tickets should be sorted by trades to obtain the actual hours, the number of hours converted into eight-hour days, the total pay received and the pay per eight-hour day. The total pay in this case should check with the totals under paragraph (a) and paragraph (b).

(e) Job tickets should be sorted in order to obtain hours and pay on piece work, on day work, on overtime, on direct labor and indirect labor, and on all of these by departments. The total pay in each case should check with totals obtained above.

(f) Job tickets should be sorted by labor operations and by job accounts or product unit numbers for posting to the cost summary sheets.

Expense Classification and Distribution

Costs of direct labor and direct material entering into production are applied directly to the job account or product unit. Costs of indirect labor and indirect material and other operating and fixed charge expense, which cannot be applied directly to the specific job account or product, are included under "expense."

To obtain accurate and uniform distribution of expense to the job accounts, the expense items are grouped under specific classes and expense accounts as given in the classification of expense.

Expenses are applied to the job accounts or product units after they have been distributed to the specific departments.

To accomplish the purposes set out above, all expense charges which fall under specific departmental groups have been included under departmental expense divisions. Those expense charges which are not departmental in their nature are included under non-departmental expense divisions.

The principal divisions and definitions in the expense classification consist of the following:

1. Productive Departmental Expense.
2. General Works Expense.
   (a) Departmental.
   (b) Non-Departmental.
3. General Works Distributive Expense.
4. Auxiliary and Stock Manufacture Expense.
5. General Administrative Expense.
   (a) Departmental.
   (b) Non-Departmental.
6. Fixed Charge Expense.

Under each of these divisions are included specific expense accounts to which all expense charges should be made directly:

1. *Productive Departmental Expense* includes the indirect charges of the respective productive departments.
2. *General Works Expense* includes the indirect expenses chargeable to production costs which cannot be charged directly to some definite productive department and which cannot be applied to one of the other classes of expenses in the classifications which follow:
3. *General Works Distributive Expense* includes all expenses directly attributable to the operation of the general works distributive departments.
4. *Auxiliary and Stock Manufacturing Expense* includes all expenses incurred in the operation of an auxiliary and stock manufacture department.
5. *General Administrative Expense* includes all expenses in connection with the conduct of the general administration or office activities of a shipbuilding company.
6. *Fixed Charge Expense* includes all expenses such as rent, taxes, interest paid or accrued, insurance and depreciation, which are more or less fixed in character, being incurred whether the plant is in operation or not.

Definitions and the manner in which each of the items of expense should be treated are set out clearly; so that the uniform basis of distributing expense and applying such expense to the cost of the product units or jobs will be established. This clear and uniform policy of method of treating certain expense costs will eliminate the present divergent practices with reference to expense distribution and application.

The proposed uniform methods include the principles, definitions and treatment of all such expense items, including such items as:

(a) Express, Freight and Drayage.
(b) Spoiled or Defective Work.
(c) General Administration Expense.
(d) Advertising.
(e) Sales Expense.
(f) Rent of Floor Space.
(g) Interest.
(h) Discounts.
(i) Insurance.
(j) Taxes.
(k) Depreciation.

In order to obtain uniform basis of expense distribution to the productive departments and the application of the expense to the job accounts, it is provided that:

(a) The total cost of such of the general works distributive departments, such as the cost for power, light and heat service, etc., should be apportioned to the various departments on the basis of the actual service or benefit received by each department. Where it is possible, the distribution should be made according to meter readings or floor space used. Where meters are not installed, estimates of the horsepower used by various machines, wattage of lamps for light service, the floor space occupied for heating, etc., should be used.

(b) The general works expense should be distributed

to the productive departments (and to such auxiliary and stock manufacturing departments as may exist) on the basis of the total labor cost in the particular period in each operating department. After such general works expense has been distributed to the respective departments, it should be applied to the product units or job accounts on the basis used for the application of productive departmental expense, namely, direct labor hours.

(c) The basis suggested for use in the distribution and application of general works expense should be used for the distribution and application of the general administrative expense. This applies to both the case of distribution of central general administrative expense to the individual plants, and to the distribution of the general administrative expense of any one plant to the productive departments and to the product units or job accounts of the individual plants.

(d) The productive departmental expense (as well as auxiliary and stock manufacturing expense to their respective products) should be applied to the product units or job accounts on the basis of direct labor hours.

Cost Figures for Standards and Estimates

In addition to production and operating control, the cost figures will reach their greatest value when they are made a basis for standards and estimates. The use of operating cost figures for these purposes is premised on accurate collection, classification and distribution of the charges for material, labor and expense. The application of uniform cost methods should result in the accumulation of valuable data, to be used as the basis for the establishment of definite standards and as an aid in estimating costs of new work.

The operating statistics will show fluctuations in wages of labor and in prices of material. When unit costs fall below or above the estimates on account of changes in operation or economic conditions, the explanations given in the operating statistics will be the basis for the revision of estimates.

Standards for all elements of costs should be developed not only in terms of dollars and cents, but in terms of labor hours, machine hours, material quantities, units of count and expense per labor hour. Comparisons in terms of dollars and cents are of value in cost control. The use of units of count will be of especial value in gaging labor efficiency and material consumption and in estimating, regardless of fluctuations in rates of wages, purchase prices of materials, etc.

The comparative summary report on the major labor operations should show, in addition to the total production considered and the percent of work completed, the cost per unit and the labor hours for each operation. The labor operation standards will thus not only serve as measures of operating efficiency, but will also aid in connection with estimating.

Standards developed in connection with quantities and costs of materials should be of great value in drawing bills of materials and estimates and should provide indices for checking of the quantity and cost of materials used in each job. Such standards will also be used in some instances as measures of the state of completion of jobs.

The establishment of department expense standards is of value for control of operating costs. With uniform and definite methods of expense distribution, it is possible not only to obtain comparable standards of departmental expense within individual yards, but these standards become available for the comparisons of major expense items between shipyards.

Summary Cost Reports and Statistical Statements

The summary cost and statistical reports are the culmination of adequate cost accounting methods, and when figures become available for such reports the proper functioning of the uniform cost methods in all the shipyards is assured.

To obtain maximum benefits from the uniform cost methods and the cost figures and standards, it is important that the summary cost and statistical statements be designed and arranged with a view of furnishing to the executive such information which is necessary in order to have knowledge of costs, production and operation conditions.

If the summary cost reports are to be of greatest value to the executives, the reports should be small in number and only the more important activities should be included. The figures should be arranged in a simple manner and should be available for use at the earliest time possible after the close of the cost period.

The following are the important summary cost and statistical statements which have been laid out according to the plan of uniform cost methods recommended herein:

1. Comparative General Balance Sheet.
2. Comparative Profit and Loss Statement.
3. Comparative Statement of Production Operations.
4. Comparative Statement of Cost of Completed Jobs.
5. Statement of Work in Process.
6. Comparative Statement of Material Inventories.
7. Comparative Statement of Major Labor Operations.
8. Comparative Statement of Expense Costs.
9. Force Statement by Departments.

These controlling cost reports and statistics will be of use for the individual shipyards. Where comparisons are made between shipyards, the items to be compared will be arranged in a similar manner, the essential difference being that such reports will include comparisons of the major items in the different shipyards, whereas the individual shipbuilding reports are confined to all costs and production and operating conditions in the respective yards.

The Pittsburgh Marine Oil Engine

(*Continued from page* 629.)

seal the piston and cylinder six patented snap-rings are used. At the bottom of the piston another ring is placed, preventing oil splashing from the crank-case reaching the cylinder.

The connecting-rod is of soft, open-hearth steel, machined all over. The crank-end is of the marine type, bronze boxes lined with genuine babbitt metal. For adjustment, shims similar to those on the main bearings are used.

To avoid the possibility of cracks, the cylinder head is of a special grade of cast-iron symmetrical in design and thoroughly water-cooled. Its inlet and exhaust valves have heads of cast-iron—also of a special mixture—welded to open-hearth steel stems. The cams, rollers and pins are of open-hearth steel, hardened and ground. The camshaft is located in front of the cylinder frame above the openings for the crank-case. The bearings for the shaft have removable, split, bronze shells. As to the valves, these are operated by rockers and rods. All rod-boxes and rollers are bronze-bushed, and the entire system of cams, lower roller rockers and bearings works in a bath of oil.

A Cost System for Shipyards—III

How the System Is Operated—Practical Application in the Case of a Hull Under Construction or Under Contract

BY CREIGHTON CHURCHILL*

The system is purely a matter of collecting data for cost purposes along the lines laid down. In its main features it consists of a definition of costs, a structural classification for segregating costs to different parts of a ship, and a system of standing orders to enable cost data to be recorded according to a regular routine. Aside from approaching the subject from an organization point of view, the only unusual feature suggested is the standing order classification, which, as far as the writer knows, is not in use in any shipyard. The basic idea underlying the entire study of shipyard costs has been not only to outline a simple system but to work it out in such a way that the data accumulated can be used for making analyses by which executives may be kept informed as to unit costs as a measure of efficiency. This information, to be of maximum value, must be timely; that is to say, must be placed before the executive at certain specified times and in a comparative form such that progress for better or worse will be shown. Such cost reports in connection with daily reports of performance should tell the whole story and enable an executive to give his personal attention where it is most needed.

The System

In the actual operation of the system comprehensive and up-to-date records can be secured at a minimum of expense by the use of tabulating machines. A card used in connection with such machines has been developed along the lines proposed and is shown in Fig. 2.

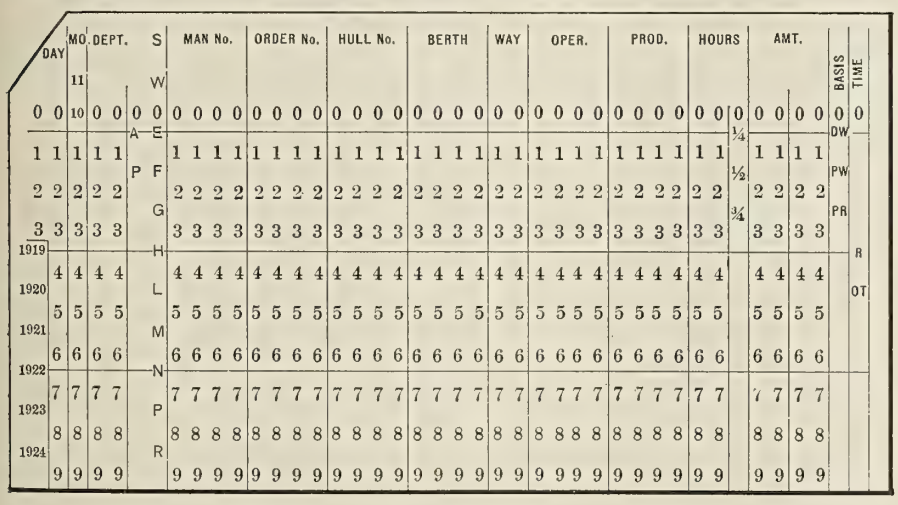


Fig. 2

The headings of the columns explain themselves, with the exception of "Berth," which is a matter of special development along the lines of structural classification which involves the method of marking steel, heretofore mentioned as a subject for another paper.

The columns headed "Operation" and "Production" record the operation and units of production so that unit costs, during certain definite periods of time, such as a week or a month or quarterly, may be ascertained. Obviously such records, for use with tabulating machines, must have a key to work from, as the information is furnished from time cards or work tickets and holes are punched in the cards to represent such operations and units of production as may be necessary. For example, the operation of riveting on the ways may be assigned the number 1 as the key number, with 100 rivets as the unit of production. If a riveter showed 600 rivets as a day's work, the card would be punched with 1 in the "Operation" column and 6 in the "Production" column. If it is desired to get the total rivet drive on the ways for a week, the cards would be mechanically sorted for that week under 1 in the "Operation" column, then put through the tabulating machine, which would turn out the week's total under the "Production" column. The same cards would give the total amount of money paid out to the riveters, consequently the unit cost is a simple matter of division. In the same way the average drive per man per week or day can be obtained and referred to a standard, indicating the performance efficiency. Keeping in mind the system of workmen's numbers, the costs by crafts on a given hull can be secured by proper mechanical sorting and tabulating or the total amount of direct labor charged to a hull up to date is obtainable. It is evident, therefore, that within the limits of the design of the card any sorting and tabulating is possible. It is customary to adopt a definite plan of procedure to be followed for everyday use and to give only such information as may be desired. Inasmuch as the cards are permanent records, they are at all times available for any special data required for unusual analyses.

If one considers a shipyard with 3,000 or more daily time cards or work tickets and the time and money required to sort and tabulate by hand the information on these, it is evident that the doing of such work mechanically would not only be more economical but would immensely reduce the chance for errors. With the machines the only chance for error is in punching the card. The writer holds no brief for tabulating machines and suggests their use from actual experience. To cite an instance, he recommended their use in a munitions plant and did the work with six clerks that the comptroller had estimated would require over twenty to do it by hand. Where a large number of men are employed the use of these machines is most certainly justified, provided the impossible is not expected and the card is designed in accordance with requirements.

Assuming the use of the tabulating machine card for accumlating labor charges and production records, it is but another step to use a properly designed card of another color for material charges, thus securing permanent records, covering practically all the information necessary to a complete record of operation, in such shape that it

* Member of the firm of Churchill & MacLeod, New York.

may be used to the greatest possible advantage. The design of such a card is merely a matter of providing that the material charges are made to proper accounts in accordance with the general scheme.

To illustrate the practical application of the proposed system the eight requirements will be used as captions, under each of which examples will be given in more or less detail showing its workings, using for the purpose a hull, No. 17, which may or may not be one of several of a similar type, being constructed under a certain contract.

1. *Provide for all charges for direct labor and direct material*

All charges under this requirement are covered by "Standing Orders—Output" on page 547. For example, all direct labor on hull No. 17, Main Steel Structure, would be charged to 17-10, as would also all direct material. The specific operation of riveting would be charged to 17-10-1, assuming that the figure 1 represents the operation of riveting. If the figure 2 represented the operation of cutting out defective rivets, the charge number would be 17-10-2. It is evident that the classification of operations by numbers, as above outlined, can be carried to any degree of refinement required or desired. Irrespective of the extent to which it is carried, it does not involve the men on the job, for it is used only by the cost accounting department through the description of the work, which is or should be recorded on all time cards or work tickets.

Should the direct labor cost be desired by production centers, the organization symbol in connection with "Standing Orders—Output" furnishes the proper charge number. For example, 1PH-10 would cover all direct labor on the ways, or 17-1PH-10 the direct labor on the ways on hull No. 17. In the same way, 3PH-10 is the charge number for direct labor in the plate and angle shop, and 17-3PH-10 the direct labor in that shop for hull No. 17.

The direct material charges are made direct from stores issues, hence have no bearing on the information required to be recorded on time cards or work tickets covering direct labor. For this reason the same number in the standing order classification can be used for both labor and material.

2. *Provide for all charges for indirect labor and indirect material, located at its source as far as possible*

This requirement is covered by "Standing Orders—Maintenance and Repair." For example, labor of an indirect character in the upkeep of the yard would be charged to 3PP-100. The same labor in the machine shop would be charged to 1PM-102. Repairs to a locomotive crane is covered by 2PP-102 for both labor and material. General office janitor service would be charged to AG-101 unless all janitor service is charged to "Maintenance and Repair," in which case the charge number would be 3PP-101. In the same way, defective castings would be charged to 3PM-105 and spoiled work in the plate and angle shop to 3PH-105. Consumable supplies, such as waste, machine or cutting oils or compounds, would be charged to the shop symbol followed by the number 104.

Material charges involving repairs to equipment will bear the same charge number as the labor involved and may or may not be covered by a separate material charge, depending on whether the material is classed as consumable stores or whether it actually has to be drawn from stores on a material requisition. There will be no double charge in either case, provided proper instructions are issued and a routine established covering repair material.

3. *Provide for overhead charges other than those in* (2)

"Standing Orders—General Expense," page 547, will cover all requirements under this caption. They refer in all cases to what may be called general matters, as will be seen by reference to the classification, and they have no direct bearing on productive functions. As a general rule, all charges of this nature will be made by general accounting and not by cost accounting. In its actual application to a going yard, it should be made as extensive as may be necessary to account for all general expense without any possibility of confusion. For example, 1005 is the charge number for depreciation which may or may not be allocated at its sources, such as 3PM-1005 for foundry depreciation, depending on whether or not general or cost accounting is responsible for such allocation. Again, the charges under 1001 and 1008 should be matters for very definite instructions, more especially the latter, as they might be considered a capital investment under certain conditions and should be so charged in the general books. Attention is also called to charges under this standing order classification that should go into profit and loss rather than overhead expense.

4. *Provide for charges to structural classification*

This requirement is covered by "Standing Orders—Output," page 547, and is illustrated under (1).

5. *Provide for charges to crafts where necessary or desirable*

This is covered by "Standing Orders—Output" in connection with workman's numbers or operating classification. For example, as explained in (1), riveting on hull No. 17 is charged to 17-10-1. Riveting on other hulls is similarly charged, hence the total riveting charge is obtainable. On the other hand, this can be secured by totaling the cards of all workmen whose numbers are 1PH-1000 to 1PH-1999, and 3PH-1000 to 3PH-1999.

6. *Provide data for unit cost of all classes of output*

This requirement is met by the data recorded on the time cards or work tickets; that is to say, the production and the amount of money involved. As indicated elsewhere, proper units of all classes of work should be established. Tabulating machines are particularly useful in meeting this requirement.

7. *Provide data for estimating in accordance with structural classification*

This is simply a proper application of information gathered under (4).

8. *Provide data for cost analyses*

It is evident that this is a matter of using the information secured for certain definite purposes. For example, how much overtime was worked in a certain period or what was the comparison between the cost of certain work under overtime and regular time.

Consideration of the foregoing will show that the standing order classifications furnish a complete system of control accounts which may be utilized for tying in cost accounting with the general accounts.

While the hull structure has been generally used in illustrating the application of the proposed system, a little consideration will show that it is equally applicable to engine and boiler manufacture. In fact, properly applied, it will also serve the purposes of a repair yard, which ordinarily offers a much more difficult problem from a cost accounting point of view than a purely construction yard.

In conclusion, it is pointed out that the proposed cost system confines most of its details to the cost accounting department, where they belong, and offers to the working forces a very simple method of allocating charges at their source through the standing order classifications. In practice the organization will acquire familiarity with the system in a remarkably short space of time. With cen-

tralized production and material control in effect, it is confidently believed that ship construction costs would become a simple system of adequate and timely records, pointing the way to economies heretofore not deemed possible and enabling the industry to enter the competitive field without fear or favor.

Oxy=Acetylene Welding and Cutting at the Newport News Yard*

BY H. I. WALSH†

THE Newport News Shipbuilding & Dry Dock Company has a welding department that stands alone—that is, it is not attached to nor does it form a part of any other shop or department. All welding in the yard comes under the direct supervision of the welding foreman, and he is held responsible for all welding or cutting done on new or repair work.

In this department is a complete acetylene generating and compressing plant, consisting of three 300-pound generators, gas holders, dryers, purifiers, compressors and one hundred and fifty 225-foot and ten 100-foot acetylene cylinders. The acetylene cylinders are distributed throughout the yard, on the shipways, in the shops, on the dry docks and on ships undergoing repairs throughout the harbor.

At the angle and beam shops there is a 300-pound generator, and both the main and auxiliary shops are piped for acetylene and are now being piped for oxygen.

The oxy-hydrogen plant consists of one hundred and one cells, producing 400 feet of oxygen and about 800 feet of hydrogen per hour, two 5,000-foot gas holders, oxygen and hydrogen compressors, five hundred 200-foot cylinders, two tanks for oxygen, of 1,000 feet capacity each at 350 pounds pressure, and two for hydrogen. At present the hydrogen is mostly waste, but it is the intention to use it for cutting at the scrap yard, in the foundry and forge shop, and in other places where it can be used to advantage and where safety and efficiency are paramount considerations.

All the gas plants are working twenty-four hours per day, six days per week, and three hundred 220-foot cylinders of oxygen are being purchased from the open market per week.

The welding shop is equipped with all modern appliances for handling welding jobs, such as brick furnaces, portable and electric hoists, cast slabs and welding tables. Oxygen, acetylene, hydrogen, city gas and low- and high-pressure air are all piped into this shop. Hydrogen is used also for preheating castings instead of city gas or charcoal. At present about forty acetylene welders and one hundred and twenty-five cutters are employed in this shop.

At the angle and beam sheds fifteen acetylene welders are employed regularly welding frames, staples, rings, and, in fact, anything that is to be welded which enters into the construction of a modern ship. The anglesmith of today has little else to do but bend to shape the material he is working, as the welders do most of the cutting and all of the welding. Six men are kept constantly busy doing both new and repair work in the smith shop. The fittings and parts that are forged and which have to be welded are done either by the electric or acetylene process, and all parts that have been heretofore worked in the fire after being welded are now being done by acetylene.

In the boiler shop and sheet iron department welders are kept busy on such work as angles, tanks, uptakes, hatches, smoke stacks, ventilators, etc. New and old castings of brass, iron, steel and aluminum; copper, brass, steel, iron and cast iron pipes and plates of all sizes and shapes are being successfully welded—in fact, anything that can be welded, from delicate parts of coin-counting machines to castings weighing from ten to twelve tons, is being welded.

All cutting at the foundry and forge shops is now being done with either the acetylene or hydrogen torch. Anything up to 24 inches in diameter can be cut by this process. In boiler and ship repair work a saving of approximately 100 percent in time and cost over the old methods is being shown. This includes such work as cutting out plates, rivets, tubes and staybolts, also the welding of patches and cracks in boilers and tanks, broken and worn parts of all kinds of machinery from the wireless fittings to main engine cylinders and bed plates.

The acetylene torch has supplanted the old charcoal basket and oil burners for heating bent frames, bilge keels, stems, stern posts, shell plates and propeller blades. Quite a number of patches have been successfully welded on bronze, cast iron and steel blades.

Since the armistice was signed, hundreds of gun platforms have been removed from supply transports by the cutting torch in a very few hours and without delaying the ship. This could not be done by any other method, time and cost being considered.

The cutting up of boilers and other scrap that naturally accumulates around large shipbuilding and repair yards and the salvaging of parts that can be used again is done quicker, cheaper and neater with the torch than by any other known method.

* From a paper read before the annual convention of the International Acetylene Association, New York, July 15, 1919.

† Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

Auxiliary Machinery on British Standard Ships

CONSIDERABLE interest is now being taken in the machinery of the standard ships built for the British Government, in view of the fact that they are ultimately to be transferred to private owners, and the question has often been asked whether in design and efficiency the best available marine practice is being adopted, especially with regard to coal consumption. It is well known that there has been no standardized design of machinery in the standard ships, each selected builder having put forward what in his opinion was the best under the exigencies of the war conditions which existed when the vessels were planned and built, and as a result many proportions in each of the different sizes of engine for the various types of standard vessel vary considerably, this being noticeable even in some of the essential details.

Under the circumstances existing in the marine engineering industry during the war, practically no progress in reciprocating engine design has been possible; but as engine builders have recently been given more latitude by the Admiralty authorities, improvements which perforce had to be hung up will now be gradually incorporated in the design and other improvements introduced. In an arrangement recently adopted by Messrs. Richardsons, Westgarth & Company, Ltd., at Hartlepool, the auxiliary condenser is embodied in the main engine structure, thereby not only effecting considerable saving in labor and material, but enabling more work to be done economically in the workshops and less work done expensively when installing the machinery on board ship. The saving in piping alone is equivalent to about 40 feet of an average diameter of 4 inches, and, further, the arrangement enables many more of the pipes and fittings to be standardized, thus permitting them to be manufactured at less cost.

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Card Indexing Magazine Articles

FOR the convenience of those readers who for reference purposes are keeping a card index file of the important articles in the engineering press, the table of contents of MARINE ENGINEERING has been revised so that the items which it contains can be clipped and pasted on reference cards without the necessity of recording the title of the article and reference data. In the new arrangement the table of contents is printed in two columns. In the case of important articles, not only are the title of the article and page number given, but directly underneath are printed a brief summary of the contents of the article and the name of the magazine and month and year in which it appeared. By clipping these items the reader is spared the necessity of filling out the index cards, and this device, it is hoped, will encourage more of our readers to acquire the useful habit of keeping a complete card index of the valuable information published in the engineering press.

Merchant Shipbuilding

SINCE the signing of the armistice, contracts for something like 145 vessels, aggregating about 750,000 tons, have been placed in American shipyards—an amount of tonnage which two years ago would have represented a record year's volume of business. The fact that orders for nearly half of this tonnage were placed within the last month shows that in spite of the dawdling of Congress in shaping up a definite policy regarding the future of the American merchant marine the shipping industry is gaining confidence and intends to take advantage of the unprecedented turn of affairs which has again restored the American flag upon the high seas.

To what proportions the phenomenal growth of the shipbuilding industry in the United States has reached is illustrated by the latest returns from Lloyd's, which show that out of the 2,526 merchant vessels of 100 gross tons or over, aggregating 8,017,767 gross tons, now under construction in the world's shipyards, 994 vessels of 3,874,143 gross tons are building in the United States, as against 782 vessels of 2,524,050 gross tons in the United Kingdom. Last year American yards turned out 3,033,000 gross tons, as against 1,348,000 tons in Great Britain. During the period January-August, 1919, American yards turned out 2,203,000 gross tons and the British yards only 630,000 gross tons. That there are no signs of any let-up in the momentum gained by American shipbuilders is shown by the fact that during the three weeks ending August 2, 9 and 16, the output from American yards totaled 69 vessels of over 1,000 gross tons each, aggregating 306,071 gross tons!

With the present phenomenal output and the recent influx of orders for new tonnage, in addition to the 8,000,000 tons still to be completed for the Shipping Board and the 1,124,473 tons under construction for the Navy Department, there surely is no reason for anyone to be pessimistic as to the immediate future of shipbuilding in the United States.

Lubricating Systems for Geared Turbines

PROBABLY the most important detail in the laying out of a geared turbine installation is the provision of a simple and reliable oiling system. So vital is the question of lubrication to the operation of the machinery that too much attention cannot be given to the design and layout of the oiling gear fitted. The pressure system of lubrication is always adopted in modern turbine installations, and in addition to providing for the lubrication of the main bearings of the turbines themselves, provision must also be made for the efficient lubrication of the gears, this comprising the lubrication of the various bearings supporting the pinion shafts and the gear-wheel shafts, in addition to the lubrication of the teeth at their point of contact. In fact, it may be said that the problem of efficient turbine lubrication consists of the provision and the maintenance of a film of oil at every point where two metallic surfaces move the one over the other.

Two systems of lubrication have been devised, the first in which separate oil pumps are provided, usually in duplicate, and the second in which the pumps are direct driven from one of the shafts of the gearing. In the case of double-reduction gearing the intermediate gear shaft is employed for this purpose. In both systems the lubricant is delivered to a gravity tank situated as high as possible above the machinery, 20 feet being considered a minimum figure in this connection. The oil to the bearings and the gears is supplied from this tank by gravity, some form of float valve being provided to govern the delivery automatically from the pumps.

With the pressure oiling system, as found on board torpedo-boat destroyers, it is still necessary to employ some form of strainer to filter the oil before delivery to the machinery. There is, however, a danger that these may, on becoming choked up, interrupt the service.

Opinion among turbine designers is divided as to the relative merits of the oil pumps direct from the gear shaft, as compared with the independent pump. It is

recognized that under circumstances when the vessel is maneuvering for a long time, the direct-driven pumps may not be capable of supplying a sufficient quantity of oil; it is therefore usual to instal a small dependent oil pump. Moreover, with the direct-driven pump it is certain that a larger quantity of oil is circulated than is actually necessary. The independent pumps, while lacking the extreme reliability of the direct-driven pumps, are, when properly controlled, able to deliver only just that quantity of oil needed by the system, and this, no doubt, will have much to do with increasing the life of the lubricant, as well as tending to simplify the filtering arrangements.

The Propulsion of Single-Screw Ships

THE determination of the horsepower necessary to drive any particular ship at a given speed may be made by the choice of a suitable Admiralty constant or by model experiments. In the former all the factors which comprise the performance of the ship are included, and no special calculations are required to ascertain the resistance of the ship or the efficiency of the screw. Certain advantages therefore are to be gained from using the constant methods, but these are nullified to some extent by the uncertainty as to the constant to choose. Care must be taken to fix one which from previous actual experience has been obtained in a vessel very close to the type being powered. When the model experiment method is adopted the problem is only partly solved, as the effective horsepower thus obtained forms, roughly, only one-half of the total power to be installed. The choice of the proper propulsive efficiency thus becomes an important item, and this can only be done with satisfaction when the effective and indicated or shaft horsepowers of a previous vessel of similar type are known.

In the analysis of the performances of ships it has been a matter of some surprise to find that in spite of the high hull efficiency single-screw propulsion does not appear to be much superior to that with twin, triple or quadruple screws. When Sir William White many years ago gave a paper to the Institution of Naval Architects on "The Speed Trials of Recent Ships of War," this feature was referred to. Many times since then has the fact that single-screw ships do not surpass twin-screw vessels in gross propulsive efficiency been alluded to. In the case of the *Vespasian,* for example, the results of which were given by Sir Charles Parsons to the Institution of Naval Architects in 1910, the propulsive efficiency was only 53 percent with reciprocating machinery, a performance which has often been excelled by twin-screw vessels.

It has been suggested many times that the efficiency of a good propeller should be in the region of 70 percent. If this figure were accepted, the difficulty of accounting for the moderate propulsive efficiencies of single-screw ships becomes the more acute. Now it is probable that the majority of screws in common use may have such an efficiency when revolving at some particular slip, but it is certain that, when revolving, such screws are exerting the necessary thrust to drive the vessels to which they are attached at their particular speed, the real slip at which this thrust is given is greatly beyond the point of maximum efficiency. This point has been admirably illustrated by the latest experiments of McEntee in the Washington tank.

A certain propeller was attached to four separate models and propelled in the Washington basin. It was found, by independent experiment, that this particular screw had a maximum efficiency of 71 percent at about 13 percent real slip. The efficiency curve then fell rapidly, until at 53 percent real slip the efficiency was only 50 percent. The models were of a full cargo ship and the slips at which the screw was working when the necessary thrust was given varied from 40 to 50 percent in the four models tried. The actual efficiency of the propeller within these limits was 60 percent. On a basis of shaft horsepower the hull efficiency value was 1.05, the wake being greater than the thrust deduction loss. If it be assumed that the mechanical efficiency of reciprocating machinery is 90 percent, this 63 percent on the shaft horsepower basis would be reduced to about 56 percent on a basis of indicated horsepower—a not unreasonable figure.

It must be remembered that, although in single-screw vessels the propeller is placed most advantageously from the wake standpoint, a large thrust deduction factor is generally associated with these high wakes.

In the measurement of wake values in a model basin it is possible that some errors arise, not necessarily in the determination of these factors, but in their direct application to full-sized ships. In model experiments the frictional resistance is a greater proportion of the total than is the frictional resistance of a full-sized ship; that is, a correction must be applied to the model resistance in order to arrive at the proper ship resistance. If, then, the frictional resistance is magnified in model results, is it not more than likely that the frictional wake is also greater than would obtain in the actual vessel? What the difference would be is problematical, but it undoubtedly would have the effect of reducing the hull efficiency as measured by tank methods and go in the direction of accounting for the obtained propulsive efficiencies in single-screw ships.

The main point, however, is in the loss in efficiency due to the great slip at which the majority of single screws operate. When limited diameters obtain, the thrust necessary to propel a full slow form can only be produced when the screw is revolving with great slip, and this means on the descending point of the efficiency curve.

It will be interesting to learn from the results of the trials of the numerous cargo ships being fitted with geared turbines if the hopes of obtaining relatively high propulsive efficiencies with these are obtained. Unfortunately, the war retarded the adoption of this type of machinery in cargo ships, and insufficient data are at hand regarding the sea performances of geared turbine vessels. Should the hopes be realized, a great step will have been made towards the attainment of higher efficiencies and great economies.

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Bearing Clamps

A rather good idea came to my notice recently when I visited the engine room of a ship that was docked for repairs. The first assistant was doing some refitting work to the bearings of the main engine circulating pump. He had four pieces of pipe with tits on them bolted down

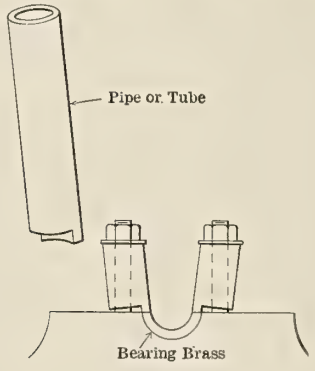


Fig. 1

under the regular bearing bolts, as indicated in the accompanying sketch. The tits of the pieces of pipe pressed down on the upper edges of the lower half of the bearing shell, as indicated; this clamped that half of the bearing down as firmly as if it were held by the upper bearing cap and its liners. With these clamps in place he did the work of spotting and scraping.

The idea is one that is worthy of attention for those who have small size bearings with shells or bearing brasses

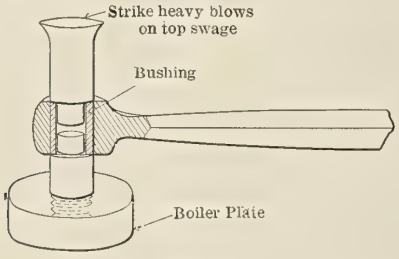


Fig. 2

that are thin and liable to spring out of true when the bearing bolts are released. The same scheme can be applied to the brasses of the caps or of the connecting rods. Bolts of suitable size must, of course, be used.

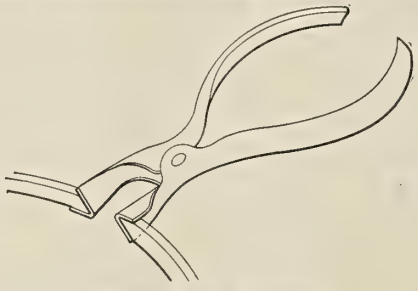
It surely has proved worth while to the writer to make these visits to brother engineers when such opportunities come. The above idea, for example, will eliminate much of my future bearing troubles, because it will now be possible for me to fit the bearing brasses clamped to their seats just as they will operate.

I also learned from him that the worn bushings of the links, rods, and rocker arms of pumps, etc., can be made to give longer service by swaging the bushings closed a small amount, and then reaming them out to fit the pin. The scheme is shown in Fig. 2. Two swages or drifts are used. The lower one is set into a base made of boiler plate; the upper one is held in place by hand. The diameter of the outside of the swages is equal to the inside of the hole into which the bushing fits, while the tip or pilot is just a few thousandths smaller than the pin on which the bushing turns. By striking heavy square blows on the top drift the small bushing is closed in sufficiently to permit light re-reaming to secure a good fit. Since on board ship there are many small bushings, such a scheme is worth using.

Concord, N. H. C. H. Willey.

Piston Ring Spreader

The piston ring spreader shown herewith was designed by an automobile mechanic, and I noted the ease with which by its use he spread the piston rings for starting them on over the pistons or taking them off. The spreader

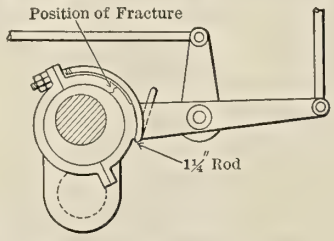


Piston Ring Spreader

is made out of 1/16-inch sheet steel. Any reader with a knack for making things can easily form a pair of these ring pliers from the sketch. When it becomes necessary to overhaul the engines of the ship's motor boats, the work of cleaning out the rings can be greatly facilitated with the use of this tool. Assistant.

Broken Eccentric Strap

An instance where it became necessary to slow down the ship because of engine trouble occurred on the steamship



Repairs to Eccentric Strap

Jacona, carrying a deckload of timber from Quebec to Leith, Scotland.

It developed that an eccentric strap on the Bremmes

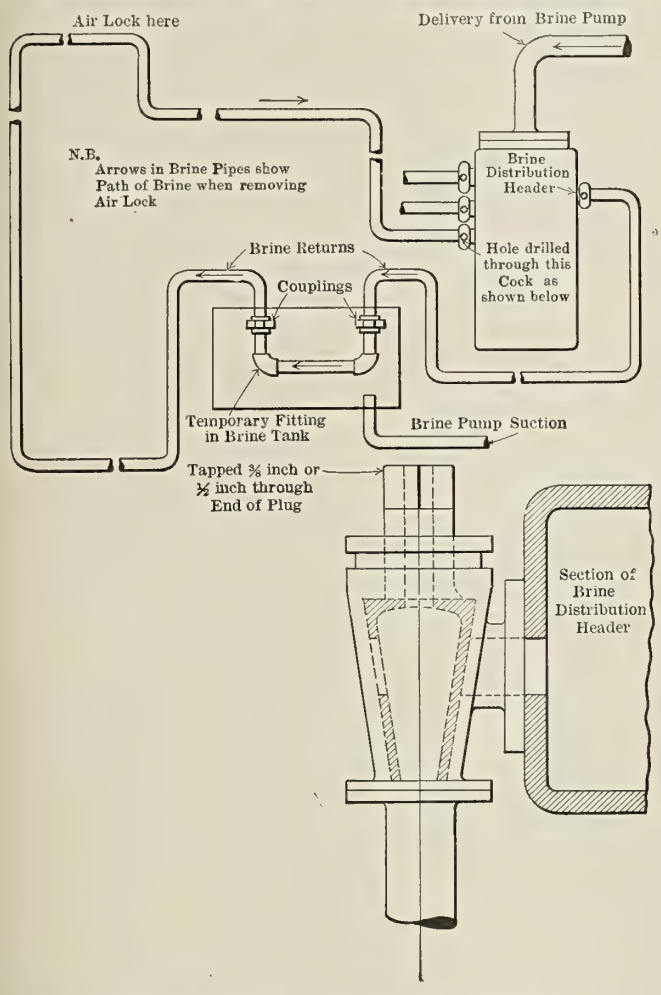
valve gear, with which the triple-expansion engine was equipped, had fractured at the point indicated in the sketch. The chief engineer devised a rapid and adequate repair for the trouble. It consisted in simply bending a 1¼-inch rod to the position indicated and bolting it there.

This repair proved a good one, for some time later the patch, which had been fitted as a permanent repair while in port, gave way and it was necessary to use the rod again.

Port Chalmers, N. Z. W. I. Esplin.

Removing an Air Lock from Refrigerating Machinery

With the safety of about half the cargo of mutton carried in a vessel of 13,000 deadweight tons depending on the immediate repair of the refrigerating machinery, a



Sketch Showing Method of Clearing Brine Pipes of Air

rapid method was devised for cleaning the brine pipes of an air lock causing the trouble.

The refrigerating plant in question consisted of duplicate sets of carbon dioxide machines and brine circulating systems for cooling the holds. Soon after leaving port, two of the systems ceased to operate and it became necessary to remedy the trouble immediately.

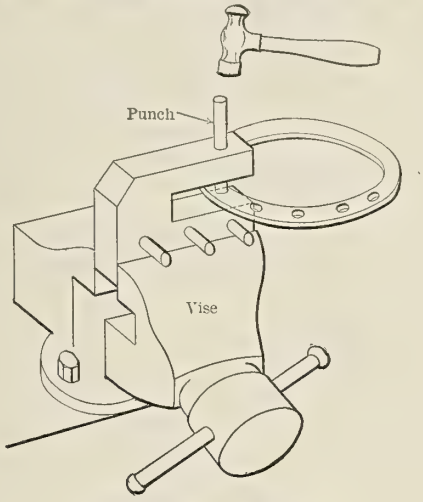
A hole was drilled and tapped in the cock at the brine distribution header, as indicated in the sketch. When the pumps were started a mixture of air and brine was ejected from this hole. As soon as a steady flow of brine indicated that the air has been entirely exhausted from the system, a plug was fitted into the hole in the cock. No further trouble with the air lock was experienced.

Port Chalmers, N. Z. W. I. Esplin.

Bench Vise Punch

Where anyone has need for such a tool it will be hard to beat this type of home-made punch for small size holes. The sketches herewith show both the details and a view of the punch in use.

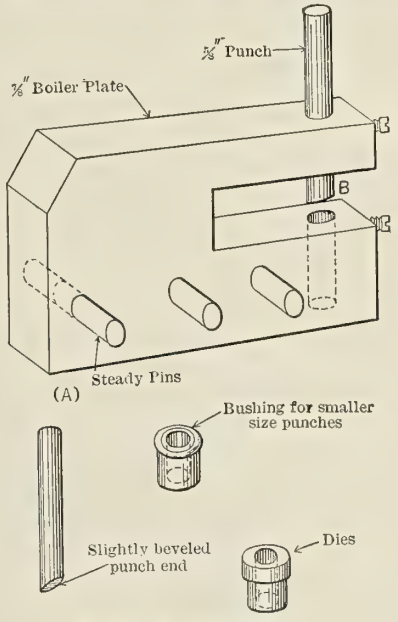
A piece of seven-eighths-inch boiler plate is used to make the frame. Steady pins are put into the frame as



Improvised Bench Punch

indicated at *A*; these rest on the vise jaws and prevent movement of the frame. A slot *B* is cut deep enough to suit the thickness of work to be handled. Bushing and dies can be made, if desired, so that other sizes of punches can be used.

I have found it more convenient to make separate punches and frame for each size punch, since these are



Details of Vise Punch

very easy to turn out. For punching thin sheet metal and all gasket work these punches stand up very well, and since they can be made from scrap stock in spare time they are very cheap.

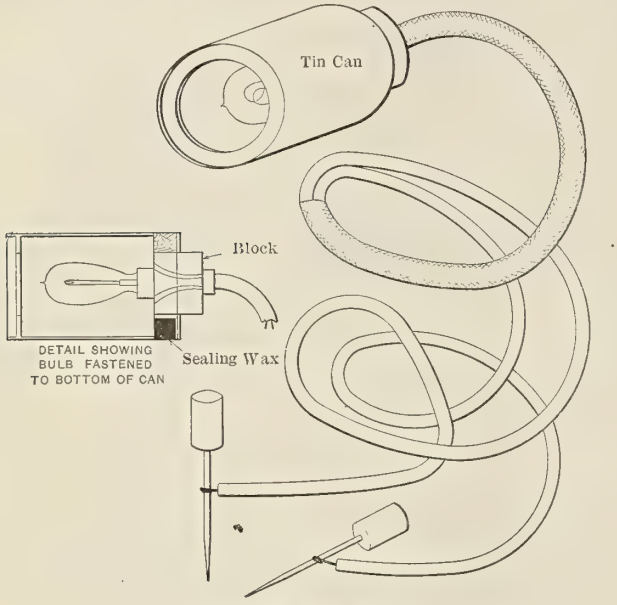
Engineer.

The Lukens Steel Company, Coatesville, Pa., is operating a new 204-inch plate mill, which is the largest in the world. The rolls are of the 4-high reversing type, each weighing 30 tons.

Unbreakable Test Lamp

In going about the ship testing for grounds and trouble the ship's electrician who carries an unprotected test lamp breaks many bulbs, and, as the breakage of bulbs runs quickly into a neat sum of money, it behooves the chief to watch the lamp costs.

The use of a small size tin can for protecting the test lamp, as shown in the sketch, will prevent the waste of



Guard for Test Lamp

bulbs by the careless electrician. A base socket is secured to the bottom of the can by means of screw bolts bolted through to a block on the outside. After the wires are connected, sealing wax is poured in around the base socket.

ELECTRICIAN.

Fan Engine Piston Repaired at Sea

While on a voyage from Antwerp to Newport News recently, the fan engine of the steamship *St. Leonards* came to a sudden stop with a crash. Upon investigation, it was found that the piston rod nut had slackened sufficiently to strike the cylinder head, breaking both the head and piston and bending the piston rod.

Running without the fan, under natural draft the ship could only make 7 knots, where it should be doing 11½

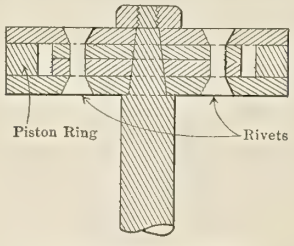


Fig. 1.—Built-up Piston

with forced draft, so that something had to be done to repair the fan engine at once. It was a comparatively simple matter to straighten the rod and make a new cylinder cover of stokehold plates, and the piston itself fashioned from the same material did not present any great trouble. The piston rings, however, were quite another matter, for all the work of fitting the old ones from the steam piston to the new piston had to be done with hammer, chisel and file. They were finally put in shape, however, and the whole riveted together, Fig. 1. This built-up piston gave good service until replaced when the ship reached port.

Port Chalmers, N. Z. W. I. ESPLIN.

Improved Valve Seat Reamer

When you tackle that job of regrinding in the engine valves of the ship's motor boat, if you have on hand in the scrap bin an old discarded valve, try the stunt shown in Fig. 1.

A reamer can be made by cutting teeth around the circumference of the valve seat. Cut the teeth as accurately as possible with a file, then caseharden the valve head and you will have an improvised valve seat reamer that will quickly remove the scale or carbon from the seats. If the valve is of good steel it will harden well enough to ream

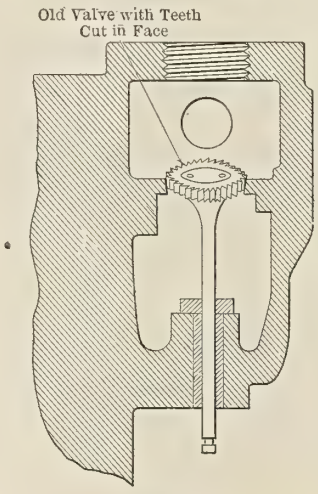


Fig. 1

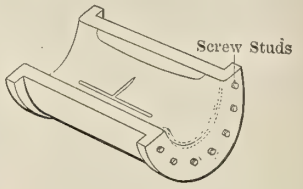


Fig. 2

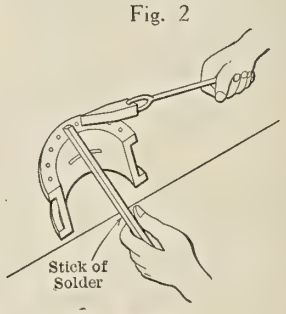


Fig. 3

off a light chip or pitted seats. The stem is left on to act as a guide. The reamer is turned by a regular valve grinding tool which engages the holes in the valve top.

BUILT ON END BEARING

One of the sets of end brasses of a small gas engine which drove motor boat propellers in a test tank had become worn at the ends, due to shaft thrust. The thrust block had not been properly adjusted. When the engine was returned to duty in the shop it was found necessary to overhaul it. The work of building on the worn ends of the brasses was accomplished as shown in the sketches Figs. 2 and 3. Several small holes were drilled and tapped in the flange of the brass and small brass screws put in and cut off about an eighth of an inch long. Then, as shown in Fig. 3, the end was treated with acid and heated and banked with solder run on generously with the copper. The bearing was then filed and scraped to a neat fit. This eliminated the end play and was far cheaper than the cost of obtaining and fitting a special set of new brasses.

C. H. W.

Several of the ore steamers belonging to the Grangesborg Oxelosund Company, Sweden, are equipped with ice chests of especially good insulating qualities. A record of the installation on the steamship *Narvix* during a trip from New York to Gothenborg, Sweden, shows that of the original 3,000 pounds of ice put in the chest June 20, about 100 pounds remained on July 14. Food had been kept in perfect condition all this time. The box was placed on the poop deck and subjected to the direct rays of the sun throughout the voyage. The dimensions of the chest are 12 feet by 7 feet 3 inches by 7 feet and it is insulated with 4-inch encysted balsa wood covered with ⅞-inch spruce strips inside and out.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Steering Gear Layout

Q. (1015).—What is the best way of connecting the steering wheel with the steering engine?

A. (1015).—Your question is somewhat indefinite, since the best method of running the control gear from the steering stand to steering engine will depend in part upon the position of the latter and the type of ship.

In many American sound and coastwise steamers the steering engine is placed directly under the pilot house. This allows a vertical control shaft which (except perhaps for an expansion joint to allow for any straining of the deck) will be devoid of bevel gears and knuckle joints. By this method the wheel can be easily handled and the gear is dependable. The engine is commonly connected to the quadrant by a chain and steel rods.

Placing the steering engine in the engine room has the great advantage of giving the engineers in charge no excuse for neglecting it, and may also save the increased attention and upkeep of steam and exhaust pipe lines. The attachment from the steering engine drum is usually by chain and rods to the quadrant, which must be overhauled at intervals. The writer has known of a case in which several of the links, 1⅛ inches in diameter, were worn two-thirds of the way through in eight months.

A quite common practice in modern vessels is to connect the steering engine directly with the rudder quadrant by worm and spur gearing, or to the rudder yoke, as with the screw type steering gear. In the cheaper installations the rudder stock is rigidly held; there are no springs to relieve rudder strain—in fact, the installation of a quadrant worm gear in many of the wooden steamers may account for the failure of the rudder stocks of these ships. However, with a steel rudder stock of good proportions, and the doing away with the wire rope or chain connections from engine to gear, the danger of the steam steering gear being thrown out of commission is in a great measure relieved. Where the steering engine is not directly below the steering wheel, shafting with bevel gears and knuckle joints, or wire rope working on drums near the steering wheel and engine are used.

It is usual to design the gear so that from 6 to 8 turns of the wheel will throw the helm from hard over to hard over. It is quite surprising how easily a properly installed control shaft made up of several lengths of shaft and bevel gears will turn. Special attention should be paid to the keys in gears and knuckle joints, since they have a tendency to work out. The alinement of shafting is also important, and where the vessel is liable to work, as in a wooden ship, or where the distance from the pilot house to the engine is great, the use of wire rope control is fairly satisfactory. One layout calls for the use of blocks at all bends; where the lead is straight the wire may be run through piping or brass fairleaders spaced every six feet. The diameter of the sheaves should be about twenty times the diameter of the ropes or over. A means of taking up the slack in wire is essential.

The telemotor installation has some good features, since the piping may have numerous bends and may be of great length without increasing the friction of gear. Care must be taken with this type of steering apparatus so that no air shall be permitted to get into the system, since it is thereby rendered useless.

Engine and Propeller for Motor Boat

Q. (1018).—I intend to install a 30-horsepower engine in a motor boat, hull 35 feet long by 7 feet 9 inches beam at waterline, and 20 inches molded draft (skeg will extend below). What speed may I expect and what size propeller should I install? The engine develops 30 horsepower at 800 revolutions per minute. The boat is of runabout model, transom stern, and of ordinary construction.

A. (1018).—If your lines are free and easy, a coefficient of $c = 9$ in formula

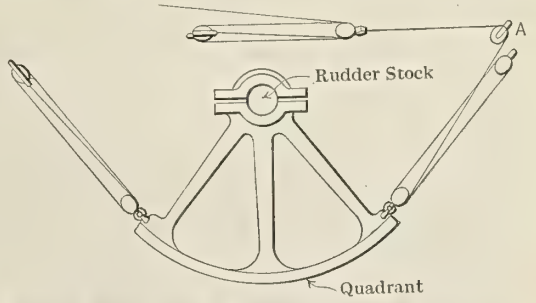
$$v = c\sqrt[3]{\frac{L \times \text{brake horsepower}}{\text{Beam}}} \quad \text{(Keith's formula)}$$

will give about 12 miles per hour. A propeller of 22 inches diameter and 82 inches pitch should prove satisfactory. L = length of waterline.

Relieving Tackle

Q. (1019).—What is a relieving tackle (as applied to a steering gear) and when is it necessary to have the same installed? A. C. J.

A. (1019).—The United States Steamboat inspection rules call for a relieving tackle on all steamers unless an auxiliary steam or hand gear is provided which is entirely independent of the regular gear. Where the steering engine is amidships, a relieving tackle may be rigged to prevent excessive strain coming on the steering rods or chains due to a rough sea.



Sketch Showing How Relieving Gear is Rigged Up

The sketch shows one way of rigging up the gear; it is really nothing more than two tackles rigged so that as the tiller slats over to one side, one tackle pays out and the other is hauled in. If desired, a means of taking up the slack may be provided by reeving the end of the starboard tackle through a guide block A and attaching the same to a watch tackle. This tackle may be rigged to handle the rudder entirely independent of the steam gear.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

SHIPPING BOARD ABOUT TO DISPOSE OF 137 STEEL AND WOOD VESSELS

About $89,000,000 Involved in Three Deals—Ships to Carry Coal to France and Italy

Early in the month the Shipping Board announced that the sale of 100 vessels of the Frederickstadt type at the rate of approximately $210 per deadweight ton was about to be consummated. These vessels vary from 3,300 deadweight (2,200 gross) to 3,600 deadweight (2,400 gross) tons. The negotiations are being handled by J. Herbert Anderson, 165 Broadway, New York City, representing the Anderson Overseas Corporation. About $80,000,000 is involved in the transaction. These vessels, which have a coal-carrying capacity of from 350,000 to 450,000 tons, will be used for that purpose by France and Italy in the present emergency.

On the Pacific Coast the Government, it is reported, is about to sell four 3,720-ton steel steamers to the Pacific Mail Steamship Company, 508 California street, San Francisco, at an average cost of $200 per ton. The vessels are oil burners, capable of making 10 knots.

On August 27, the Shipping Board announced the sale of three steel steamers to the Coastwise Transportation Company, Boston; two to J. E. Dockendorff & Company, New York; one to the Fidelity Steamship Company, Boston, and one to W. R. Grace & Company, New York.

In addition the Shipping Board announced on August 3 that a cable had been received from its London agent announcing that a purchaser stands committed to take over twenty wooden steamships of the Ferris type; that the prospective buyer has deposited funds in the bank awaiting the acceptance of his chase of 100 additional ships has been granted to the same party. The cable asked authority to sign the contract, and this permission was cabled.

Wood Ship Sales

All the wooden vessels to be sold in this particular group are of 3,500 deadweight (2,333 gross) tons. The purchaser pays $300,000 for each vessel. This sale brings the total number of wood ships disposed of up to fifty-eight. The Board now has 174 wooden vessels in various services.

H. E. Frick, district manager of the United States Shipping Board, reports the sale of six uncompleted hulls to the Universal Shipping & Trading Company, Seattle, Wash. These vessels have been stored in Lake Union pending sale. As may be noted in the illustration approximately thirty of these vessels are tied up at this place. Negotiations for twelve more hulls are being carried out, and it is probable that other sales will be reported in the near future.

JAPANESE INTERESTS FORM STEAMSHIP COMBINE

Kokusai Kisen Kaisha Formed With $50,000,000 Capital

The Kokusai Kisen Kaisha (International Steamship Company) has been organized in Yokahama with a capital of $50,000,000 to carry on extensive steamship service between New York, South America and the Orient.

The line is to have 499,500 tons of ships under its operation. According to a statement, issued by K. Doi, no American capital is involved. The following distribution of shares has been announced:

	Tonnage	Number of Shares
Kawasaki Dockyard Co...	275,000	1,100,000
Suzuki Company.....	84,300	337,600
Asano Shipyards.....	51,500	206,400
Hashimoto Kisen Kaisha.	25,400	101,600
Yamashita Kisen Kaisha.	23,600	94,000
Uchida Kisen Kaisha....	17,300	71,200
Nippon Kisen Kaisha....	17,300	69,200
Ishikawajima Shipyard...	5,000	20,000

Fore River Plant to Build Battleship No. 54

On August 1, Josephus Daniels, Secretary of the Navy, announced that battleship No. 54, to be named the *Massachusetts,* will be constructed by the Fore River plant of the Bethlehem Shipbuilding Corporation. This ship, which is the last of the authorized battleships to be contracted for, will have a displacement of 43,200 tons.



Thirty Wooden Vessels Moored in Lake Union Awaiting Sale. These Hulls Represent the Expenditure of About $12,000,000

CONTRACTS FOR 49 LARGE VESSELS ANNOUNCED; 200,000 TONS FOR U. S. STEEL CORPORATION

Fore River Plant Receives Orders for 79,800 Tons—Federal and Chickasaw Yards to Build Twenty Ships—Ten Steel Trawlers, Four Fruit Vessels and Various Cargo Steamers Included in Orders.

The placing of ship contracts during the last month by domestic and foreign commercial interests with American shipbuilders emphasizes the essentially permanent character of this industry in supplying the necessary tonnage for American and foreign operation. Work has started on the construction of twenty steamships of about 10,000 tons each for the United States Steel Corporation at the yards of the Federal Shipbuilding Corporation, Kearny, N. J., and the Chickasaw Shipbuilding Company, Mobile, Ala.

In addition to a 43,200-ton battleship for the United States Navy, the Fore River plant of the Bethlehem Shipbuilding Corporation has received an order for two 12,600-ton steel tankers from the Standard Transportation Company, 26 Broadway, New York. This yard also holds a contract for an 11,400-ton Diesel-engined ore carrier, which will run between Sparrow's Point and Cuba, for the Ore Steamship Company, 111 Broadway, New York. This vessel is one of a fleet of ten which will be built for this service as a part of the $50,000,000 development authorized by Charles M. Schwab for Sparrow's Point.

The East Coast Fisheries Company, 7 Wall street, New York, has placed an order for three steel trawlers with the Portland Shipbuilding Company, South Portland, Me. The engines will be built for these vessels by the Portland Company, Portland, Me. Contracts will soon be announced regarding two additional vessels which the company intends to build to complete the new fleet of ten vessels.

The Newburgh Shipyards, Inc., Newburgh, N. Y., has received a contract to build two 300-foot 10-inch vessels for the Cuyamel Fruit Company, New Orleans, La. These vessels will be twin-screw steamers of steel, having triple-expansion reciprocating engines and three Scotch boilers, with an estimated speed of 15 knots.

The International Ship Building Company, Pascagoula, Miss., it is reported, has received a contract to build six 10,000-ton ships for private interests.

The Pusey & Jones Company, Gloucester, N. J., has received a reinstatement on two 13,000-ton ships ordered by the Emergency Fleet Corporation. Work will be begun upon these vessels at once.

The Manitowoc Shipbuilding Company, Manitowoc, Wis., has received a contract from the Atlantic Fruit Company, 61 Broadway, New York, for two vessels of 3,200 deadweight tons.

The Norwegian-American Line, 8 Bridge street, New York, has placed a contract with Napier & Miller, Glasgow, Scotland, for two 435-foot vessels of 9,000 gross tons. These ships will be constructed to burn either coal or oil as fuel. Parsons turbines will be installed. The same company will build two 7,500-ton cargo vessels equipped with triple expansion engines.

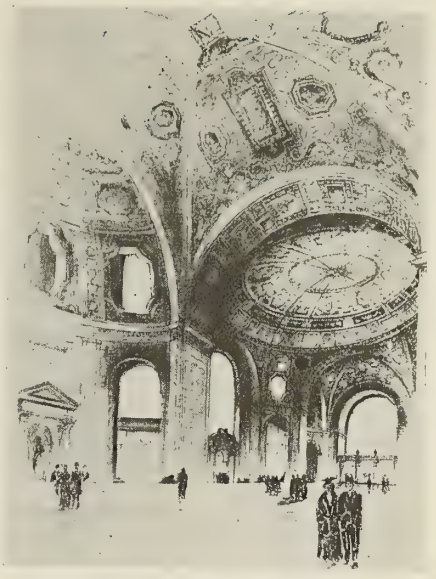
The Downey Shipbuilding Corporation, Staten Island, N. Y., holds a contract from the Coastwise Transportation Company, Boston, Mass., to build a cargo steamer of 7,800 tons deadweight.

The Long Beach Shipbuilding Company, Long Beach, Cal., has received a contract from the California & Mexican Steamship Company for a 300-foot motorship.

Although the rumor has been specifically denied by William Cornfoot, president of the Albina Ship & Engine Company, Portland, Ore., regarding the placing of contracts for four 6,000-ton steel ships at that yard for Scandinavian interests, the report is still current, and it is probable that announcement is delayed awaiting the final signing of the papers.

The Coastwise Shipbuilding Company, Baltimore, Md., we have been advised, is negotiating to build six four-masted schooners; four of these vessels of 2,000 tons deadweight will be constructed for the Inter-American Transportation Company, and two of 1,600 tons deadweight for the Chesapeake & South American Transportation Company.

The Howes Construction Company, Meteghan River, N. S., has received a contract to build a bay steamer for the Valley Steamship Company.



Architect's Drawing of the Rotunda in the New Cunard Office Building

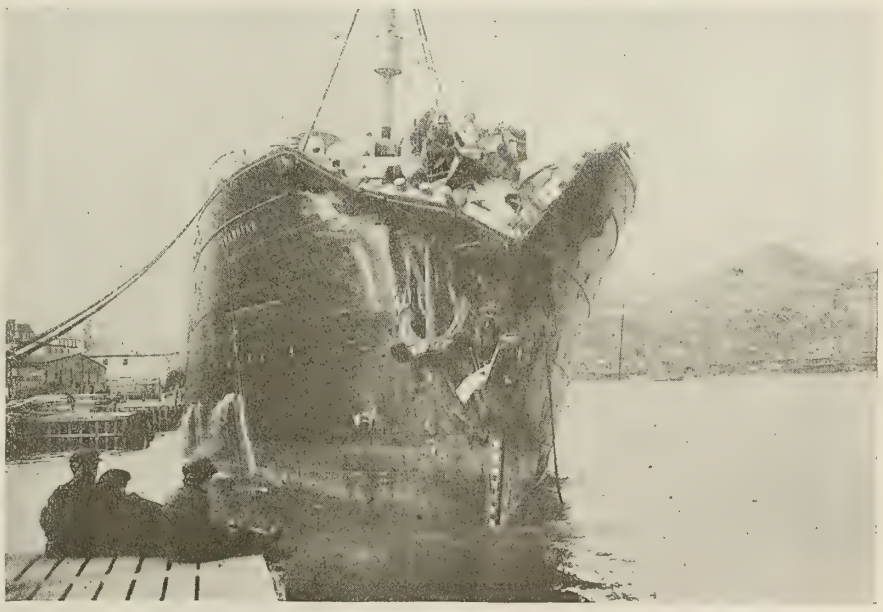
Cunard Company to Build New York Office Structure

The Cunard Steamship Company, Ltd., with which is allied the Anchor Line and the Anchor-Donaldson Line, plans to build a 21-story office building in New York City on a plot of ground adjoining Morris street, bounded by Broadway, Morris and Greenwich streets.

The acquisition of the land has involved the expenditure of $5,000,000. The base area of the building when constructed will be 48,400 square feet. The building is to be completed and ready for occupancy May 1, 1921.

Extensive Refitting by the W. & A. Fletcher Company

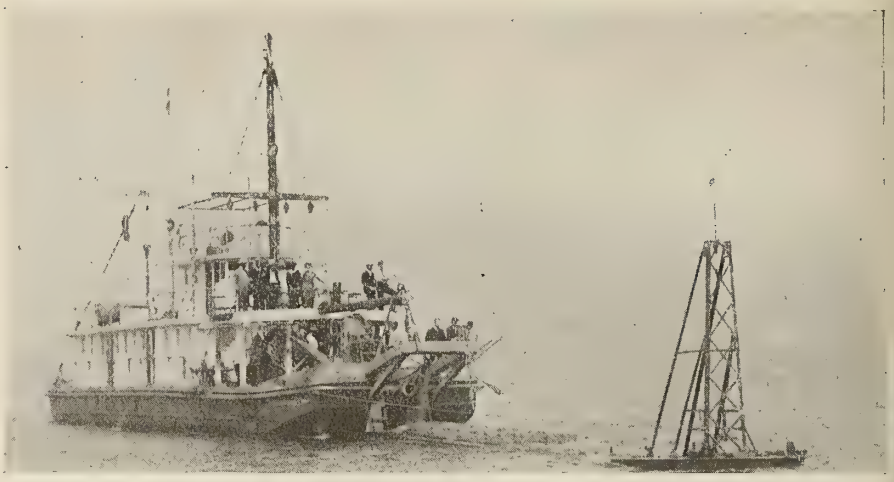
During 1919 the W. & A. Fletcher Company, Hudson street, Hoboken,



The *Grampian*, a Vessel of 6,119 Gross Tons, Which Recently Encountered an Iceberg, is Shown Here as She Was Towed Into Halifax With Bow Torn Out. Realizing the Danger of a Side Blow, the Captain Maneuvered the Boat to Receive the Contact on the Bow



The Engineer Holding the Door of the Diving Compartment Open



The *Argosy and Argonaut* With Half Submerged Submarine Before Her—When Lowered the Latter Rests Over the Ocean Floor

N. J., has refitted twenty-two vessels for troop transport service. The following ships have been handled during that time: *Minnesota, Alaskan, Arcadia, Dakotan, Paysandu, Liberator, Otsego, Virginian, Floridian, Artemis, General Goethals, Santa Anna, Santa Olivia, Santa Cecilia, Santa Rosa, Santa Paula, Radnor, Buford, Philippines, Eten, Ohioan* and *Prince Frederick Wilhelm.*

The *Prince Frederick Wilhelm* was refitted for approximately 4,000 troops in ten days. The fitting of the twenty-two vessels necessitated contract prices amounting to approximately $3,700,000. This work was carried out in addition to the company's usual repair work for the Navy Department, the United States Shipping Board, the Naval Overseas Transportation Service and other work for private owners.

Argonaut Salvage Corporation Formed for Reclamation Work

A $10,000,000 company, known as the Argonaut Salvage Corporation, for carrying on marine salvage work has been incorporated under the laws of the State of Maine by Simon Lake and associates. The first public demonstration of the apparatus, on the working possibilities of which the corporation is based, was given to a group of newspaper and camera men August 1, 1919.

The tests were carried on about six miles out from Bridgeport, Conn., in the waters of Long Island Sound, and consisted in permitting each of the party to walk on the bottom of the Sound at a depth of about 25 feet.

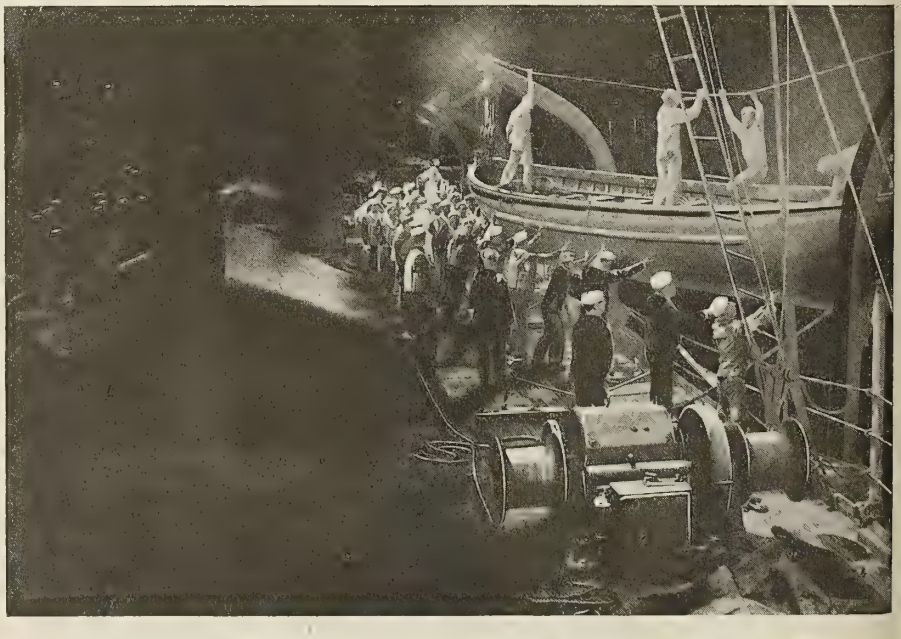
The device, which is one of Mr. Lake's inventions, consists essentially of a mother ship, to which a shaft 4½ feet in diameter is conected by means of a universal joint. At the outer end of the shaft a small submarine chamber, about the shape of a flatiron, is horizontally pivoted. This chamber contains two compartments, one an airlock, which gives access to the shaft, and the other a working chamber. Airtight doors separate the lock from both the shaft and the working compartment. The lock is about 50 square feet in area and 6 feet high, having a hinged floor that, when raised, allows operations to be conducted either on the ocean bottom or on a wreck.

When traveling on the surface, the shaft and submarine extend horizontally from the mother ship, as shown in the accompanying photograph. When operations on a wreck, or on the ocean bed, are to be conducted, the ballast tanks in the apparatus are filled, and the working chamber allowed to sink to the desired depth. The operators then descend through the shaft, which is at a more or less steep incline, depending on the depth of the water, and enter the air lock; after which the doors to the tunnel and working compartment are closed. Air is pumped into the lock until the pressure is equal to that of the water at the given depth. The door to the working chamber is then opened, the floor swung back, and operations conducted without any particular inconvenience other than that due to the limited space.

Matthews Generating Unit for Ship Installation

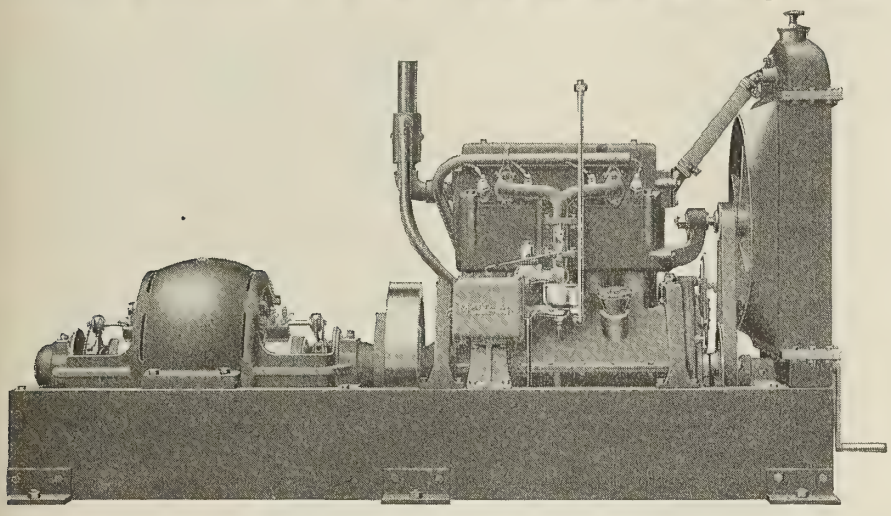
The launching of a lifeboat after a Shipping Board vessel had been torpedoed, with a Matthews lighting plant flooding lights to davits and deck, is shown in the accompanying illustration. During the war a 6-kilowatt generator, fitted with a specially designed throw-over switch, was furnished to the American International Shipbuilding Corporation, Hog Island, Pa., by the Matthews Engineering Company, Sandusky, Ohio. These 125-volt, direct-current, General Electric generators, ranging in size from 5 to 25 kilowatts, fitted with Matthews four-cylinder, automobile type engines operated with gasoline (petrol), are now being turned out at the rate of two a day from the company's plant for installation in merchant vessels. Batteries and the special automatic switch of the Government type are not furnished with these installations. A second commutator supplies 25 volts for battery charging.

In the special switchboard furnished



Matthews Lighting Plant Flooding Lights to Davits and Deck on Torpedoed Ship

for the Government, when the potential on the ship's mains drops to 85 volts, the throw-over arrangement on the back of the board instantly "throws-over," connecting the wireless and the deck lights with the Matthews generating unit and battery. If the load does not exceed 25 amperes and the batteries are fully charged, the current flows from the bat-



Matthews Six-kilowatt Generating Unit, Generator Side

teries to the wireless and deck lights without starting the generating unit. If the load exceeds 25 amperes the current will be supplied until about 20 percent of the battery capacity is consumed; then the generating unit starts automatically and supplies current as long as required. When the potential reaches 110 volts in the ship's mains the auxiliary set is instantly disconnected.

Brownhoist Wharf Crane Installed at Quebec

The port facilities of the city of Quebec are well suited for the purpose of the cargoes handled at the port, including modern wharf construction, good warehousing facilities, grain elevators and a considerable amount of modern unloading machinery. Among the additional machinery which was installed to handle the increased shipments due to the war, was a Brownhoist wharf crane. The photographs, made by the Brown Hoisting Machinery Company, Cleveland, Ohio, showing the installation, gives an idea of the value of this machinery for harbor work. This machine, which is the usual Brownhoist Portal Pier type operated by steam, travels on rails spaced 15 feet 10 inches on centers. The Portal Pier is of sufficient length to clear any railroad car using the track which runs between its legs.

A hoisting and rotating crane is mounted on the pier. The latter swings in a full circle. The crane boom, which is 55 feet in length, is equipped with a raising and lowering mechanism operated by one man; the rotation of the boom and travel of the crane along the track can also be controlled by one man. These last operations may be performed separately or combined.

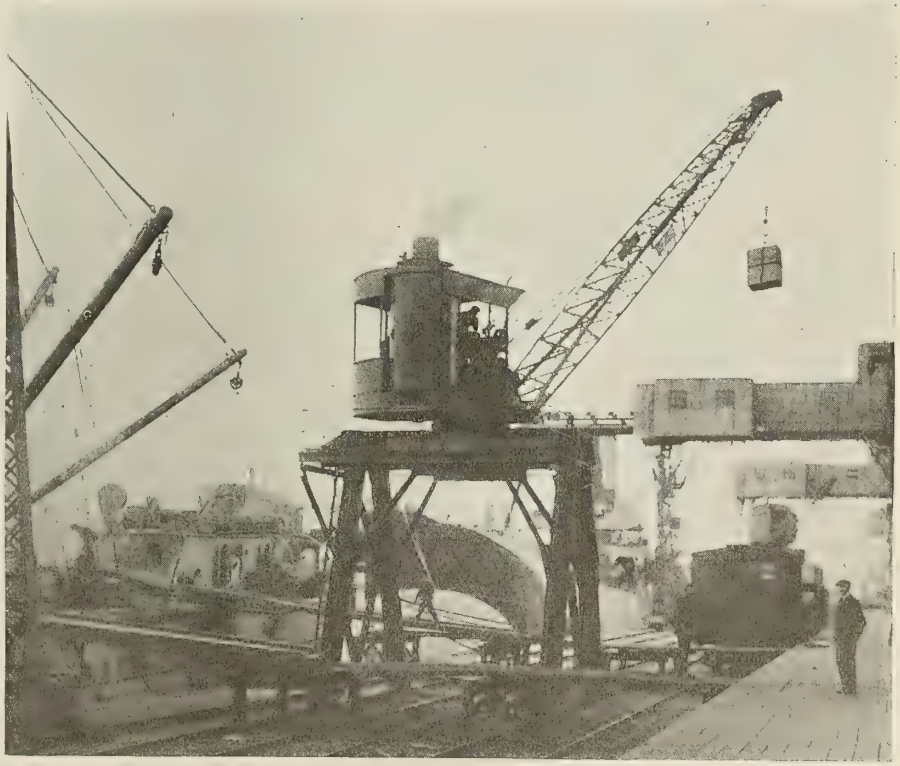
When working with a whip line a load of 9,500 pounds can be hoisted at the rate of 250 feet per minute. With the maximum load a hoisting speed of 80 feet per minute can be maintained; rotation with full load may be carried on at the rate of 300 feet per minute. The possibility of combining these two movements cuts the operating time for loading or unloading vessels. At the maximum radius of 55 feet the crane can handle 5,800 pounds; at the minimum radius of 20 feet a load of 23,000 pounds can be handled. The various functions which the crane can perform and the range in lifting capacity which it possesses make it particularly adapted for handling miscellaneous ship cargoes.

Chrobaltic Alloy for Cast High-Speed Steel Cutters

The mechanical and metallurgical arts and sciences, stimulated by war necessities, accomplished remarkable things in the past three years. Among others chrobaltic steel alloy was found to be a suitable substitute for tungsten in producing high-speed steel. In the production and use of multiple cutting edge tools, it is claimed that the use of this alloy has accomplished a saving in material and high-priced labor. It has been successfully used in making tools of intricate shapes, for blanking, drawing and forming dies, hot and cold trimmers, while in the manufacture of cast milling cutters its results seem to be satisfactory. In the cast state tools are supplied either finished, ready for use, or annealed, so they may be machined to special dimensions by the user.

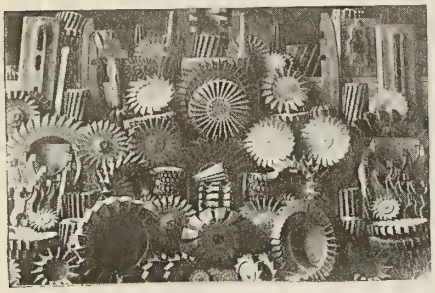
These high-speed steel castings have the appearance of smooth forgings, and are practically non-rusting and acid resisting. The alloy will resist high temperature without flaking, so that it is adapted to cutters having thin edges. The tools may be hardened in air or oil, and annealed and rehardened without the steel losing any of its properties. No change of shape is apparent under heat treatment, so the labor of finishing is greatly reduced. Cutters are cast to nearly the required size, only about one-sixteenth of an inch being allowed for machining before heat treatment. This allowance is reduced, however, so that only a small amount of grinding is necessary for hardening.

The hardening process is carried out in a furnace of the muffle type, where



Brownhoist Hoisting and Rotating Crane Installed at Quebec

the tools are heated to between 1,830 and 1,870 degrees F., maintained at this temperature a few minutes, then allowed to drop to 1,815 degrees, when the steel is withdrawn and quenched in oil. The annealing process consists in simply heating to 1,832 degrees, and allowing the material to cool slowly in air. After annealing, the casting should show about



Variety of High-Speed Steel Cutters Made from Chrobaltic Alloy

38 on the scleroscope, and may be machined rapidly.

It would appear from results that the cast chrobaltic alloy cutters disprove the former theory that rolling, pressing or forging is necessary in the production of milling cutters, in order that they might have the required density and toughness.

From data available the labor, cost and material saved in machining processes where these tools are compared with tungsten steel, as well as the labor and material conserved in their manufacture, are apparent. It is noted that in the case of the production of one completed article, when tungsten steel tools were used, ten pounds of material were required and eleven hours of labor, while with chrobaltic alloy it required but five pounds of material and three hours' labor, thus cutting the cost of production about half. The results of a test on shell billets indicate that about a pound more steel was necessary in making the tungsten cutter than the alloy, and that it required seven and three-quarter hours less labor to complete the operations with the latter.

This new alloy is supplied by the Chrobaltic Tool Company, Railway Exchange, Chicago, Ill.

Gilbert & Barker Heating Furnaces

The accompanying illustration shows a portion of the Gilbert & Barker heat treating system installed at the plant of the McClintic-Marshall Company, Pottstown, Pa., one of the largest fabricating shops utilized by the Emergency Fleet Corporation. The furnaces, which are direct fired, are used for heating shapes for rerolling and bending. The heating chambers of these furnaces are 42 feet and 52 feet long, 2 feet 9 inches wide, with an arch of the sloping type, being 1 foot high at the right-hand side and 1 foot 8 inches high at the left-hand side.

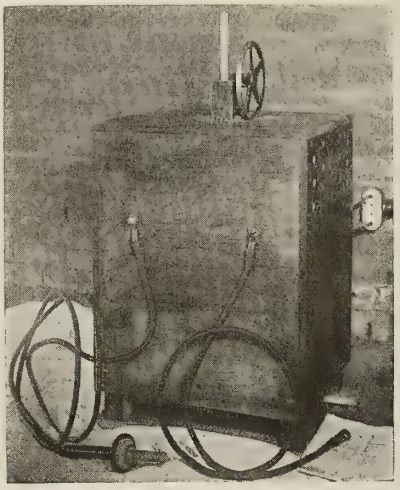
The Gilbert & Barker Manufacturing Company, Springfield, Mass., which manufactures the furnaces, advocates the installation of the 1½-pound pressure air system for general work. The patent adjustable burner, placed about an inch away from the furnace wall, so that approximately 50 percent of the air necessary for combustion is induced, permits the entry of air and oil from opposite sides. The oil enters through a central casting tipped with a cone-shaped cap; the air enters outside of this casting through a cap machined to an angle. The amount of air passing through the burner may be adjusted by means of a special gear arrangement, although the air jet remains the same. A single jet attachment, operating on air at 8 ounces or above, can be furnished for use where nearly constant operating conditions obtain. High-pressure types of burners, suitable for air at 15 pounds or above, and megaphone types for obtaining long, soft flames are also furnished.

Where shaft drive is installed throughout the plant, a positive pressure blower operating at 1½ pounds is used. With this system the oil is furnished by means of a rotary oil pump connected by chain to the shaft of the blower. When electrical current is available, the turbo compressor type of system is by far the most efficient and economical. A turbo compressor is used direct connected with the motor. Down to friction load the horsepower intake is directly proportional to the volume of air taken from the machine. With the positive pressure blower system, however, the blower must be run at full load at all times. In the turbo compressor system the oil is supplied by a motor or belt-driven rotary pump.

The Zeus Welder

The Gibb Instrument Company, Detroit, Mich., has placed on the market a new type of electric welding apparatus known as the "Zeus" welder. The current for welding is provided through a transformer instead of from a motor generator. The transformer has no moving parts to get out of order, and the manufacturers claim that the current consumption is from 20 to 40 percent less than in a motor generator.

The "Zeus" welder is of comparatively small size; portable; can be adapted to overhead welding and to the welding of cast iron. It is built on the unit system, so that whenever work becomes too heavy for the apparatus a

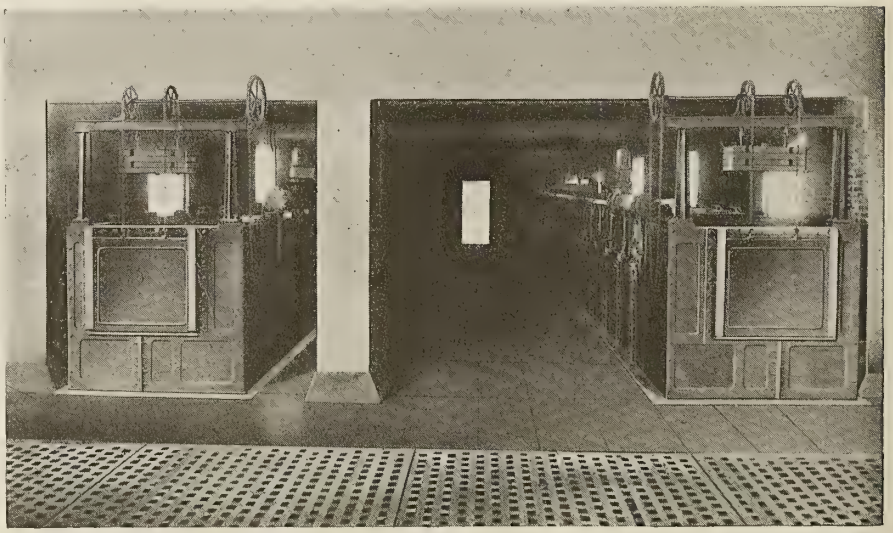


Transformer and Electrodes Which Comprise the Zeus Portable Outfit

duplicate may be connected in parallel with the original machine. A special feature is the arrangement for regulation. A wheel connected with the secondary, and extending through the top of the case raises and lowers the secondary, and provides for the regulation of the current necessary for the different sizes of electrodes. It is claimed that the inherent reactance of the "Zeus" welder automatically stabilizes the arc for different arc lengths.

Portable Propeller Pitchometer

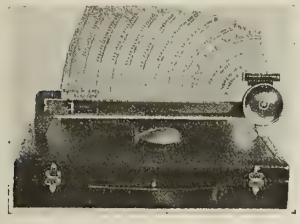
The McNab Company, consulting engineers and manufacturers, Bridgeport, Conn., is placing on the market a portable propeller pitchometer which is manufactured by Dobbie McInnes, Ltd., of London and Glasgow. This appa-



Gilbert & Barker Heating Furnaces Installed at McClintic-Marshall Plant, Which Fabricated Material for the Emergency Fleet Corporation

ratus, which is of very simple construction, may be used for testing the pitch of propellers, both in the shop and on the ship.

For shop testing, lines are drawn on the blade at various radii from the center of the boss, ranging, say, from 2 feet to 20 feet in diameter. The two resting points of the instrument are then placed on the boss, keeping the shifting arm at the bottom of the index plate. The level of the instrument is altered until the bubble is in the center of the slot. From this position the instrument is next transferred to the first pitch

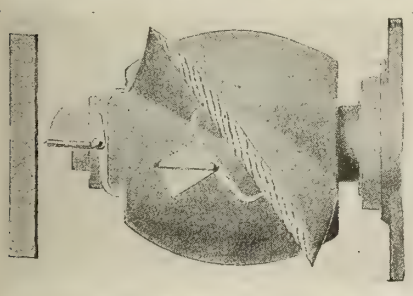


Pitchometer and Case

circle on the blade. Raising the shifting arm, which carries the level with it until the bubble is again in the center of the slot, the pitch can be read at the point where the top edge of the arm intersects the arc line of the index plate marked 2 feet in diameter. The process is repeated for the other radii. The instrument has an extending foot, so that three or four readings may be taken across the blade.

When the propeller is in position on the vessel the operation of the instrument is virtually the same, except that when the feet of the instrument are resting on the boss or nut of the propellers the level is placed at right angles to the shifting arm, which should be placed tightly against the bottom of the index plate. Having adjusted the level with the bubble at the center of the slot the instrument should be transferred to the radii line already scored on the blade; then the arm is shifted without further interference with the level until the bubble is again in the center of the slot. The reading of the pitch may be taken as noted above.

When the propeller is in position in the floating drydock, or erected so that the level is not applicable, the hinged portion of the arm is used for taking the pitch. The company advises the taking of three readings on the breadth when the instrument is used on broad-bladed propellers. This method will give a true mean and also indicate if the pitch is increasing from the cutting to the trailing edge of the propeller blade.



Testing a Propeller When Installed on Ship

When testing propellers of the ram's horn type installed on vessels, where the tips of the blades are thrown back on the round, the instrument should be placed on the down-coming blade, when the center of the smallest diameter line is at right angles to the keel. The engines should then be moved until the center of the second line is at right angles. On further moving of the engine the instrument may be kept in this position, which will secure correct results.

Strainer for Oil Systems

A duplex strainer, designed for installation in the suction or discharge lines of lubricating or fuel oil systems for the removal of solid foreign material in suspension, has been placed on the market by the Griscom-Russell Company, 90 West street, New York. It is stated that the device is also suitable for straining the water supply from rivers and lakes to prevent weeds, sticks, marine plants and small fish from entering the pipe lines.

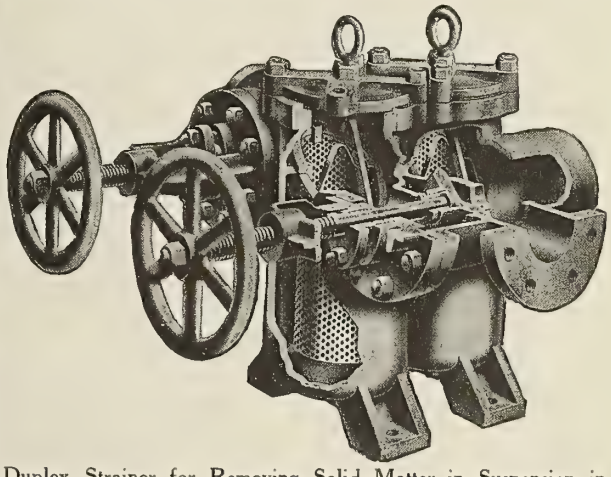
The strainer consists of a cast iron body containing two perforated steel or brass baskets. The valve arrangement permits the removal of either basket for cleaning while the other remains in service. In operation the oil or other liquid enters the inlet connection and passes into the basket in service. The solid matter remains in the basket, the clean liquid passing through the perforations and thence out of the strainer. All cast iron sections are cylindrical to give maximum strength. The valves can be reground.

Red Devil Rivet Cutter

The Red Devil rivet cutter is a pneumatic tool designed solely to cut and back out rivets. The principle of construction is simple—a plunger driven in a long barrel by compressed air striking a chisel head. The efficiency of the tool lies in the tremendous power which it puts behind every blow. One and one-quarter-inch rivets can be cut cold in ten seconds. One-inch rivets can be cut in from three to five blows.

As manufactured by the Rice Manufacturing Company, Indianapolis, Ind., exclusively for the Duntley-Dayton Company, 1416 Michigan avenue, Chicago, the valve head and nose piece are attached to the valve by being forced on under 50,000 pounds pressure. This method of construction provides a solid joining without projections to interfere in close work. High-grade springs placed at each end of the barrel reduce shock and vibration and afford easy operation. All inlet and exhaust valves are curved at an angle which permits the air to enter and leave with the least possible obstruction. An air pressure of 90 pounds, the company reports, will give the best results, although the machine will work fairly well on pressures as low as 40 pounds.

Only three men are required for the operation of the tool. The operator controls the left handle with his left-hand and rocks the valve handle with his right. An assistant holds the chisel on the rivet. At the opening of the air port, by the turning of the valve handle upward, the full force of air acts on the plunger, driving it down the barrel until it strikes the chisel head. On throwing the valve handle down to exhaust, the plunger returns to the head of the tool ready for the next operation. After the rivet is cut it takes but a moment to remove the chisel and insert the backing-out punch. Countersunk rivets are punched through with the latter attachment.



Duplex Strainer for Removing Solid Matter in Suspension in Oil Systems

Oil Forge for Heating Rivets

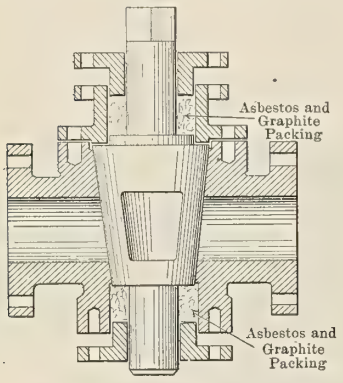
An oil forge for heating rivets has been devised by J. T. Shepherd, plant plumber for the Pacific Coast Shipbuilding Company, San Francisco, Cal. It is claimed that backfiring is eliminated, and that a higher vaporization of the oil is secured by the use of this forge.

The main features are a valve in the air line and a needle valve in the oil supply pipe, with a mixing chamber formed of a 1¼-inch T, having a 1¼-inch nipple and a bell reducer. A second mixing chamber above the first is formed of a 1-inch ell, supplied with oil from a 1½-inch T and a ⅜-inch nipple injector. Free oxygen is taken in with the vapor. A male hose connection obviates the necessity of using a leader.

In order to reduce the danger of damage to the forge, a stay plate protects the piping where the valves are controlled. The forge is also equipped with bleed valves, making it possible to clean out the tanks easily. Not only can the water be bled from the oil but the bottom of the tank can be blown clean.

Double Packed Stop Cock for High Pressures

A new blow-off valve, especially designed for high pressures, is being produced by the M. H. Treadwell Company, Inc., 140 Cedar street, New York City. It is essentially the taper plug type valve with certain refinements tending to keep it tight in the seat and to overcome sticking. The stop cock must be tight and free from pitting and grooving to prevent leakage. It is advisable to give a cock two or three turns instead of only a half or quarter turn, so that the plug will not wear excessively on one side.



Taper Plug Type Valve for High Pressures

In the case of the new plug, if it is too tight, it may be lifted out, but this should not be done unless absolutely necessary, for there is a chance of getting grit and gravel between the valve and seat. If this occurs the seat will be scored badly and leaking will result.

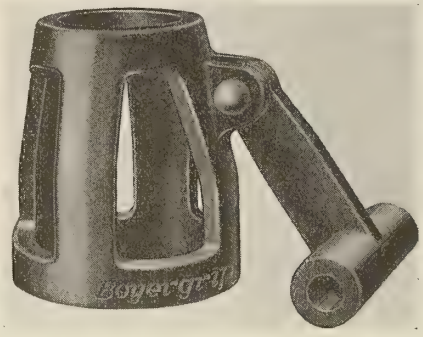
The stop cock is carefully packed on top with soft asbestos and sprinkled with dry graphite, both ends of the packing rings fitting close together. The top gland is then tightened so that the plug will barely turn, after which the bottom is packed in the same manner, the packing being drawn tight enough to release part of the pressure at the top. This equalizing of the pressure will enable the stop cock to turn quite freely.

It is stated that, if handled with ordinary care, this stop cock will never give trouble, as both ends are packed and lubricated and move under the same conditions as a shaft in a lubricated bearing. If the valve sticks when not in operation the gland at the bottom may be screwed up until the cock is released.

Device for Use on Pneumatic Riveting and Chipping Tools

A new attachment, known as the *Boyergrip*, for facilitating the handling of pneumatic riveting, chipping and calking tools, has been produced by the Chicago Pneumatic Tool Company.

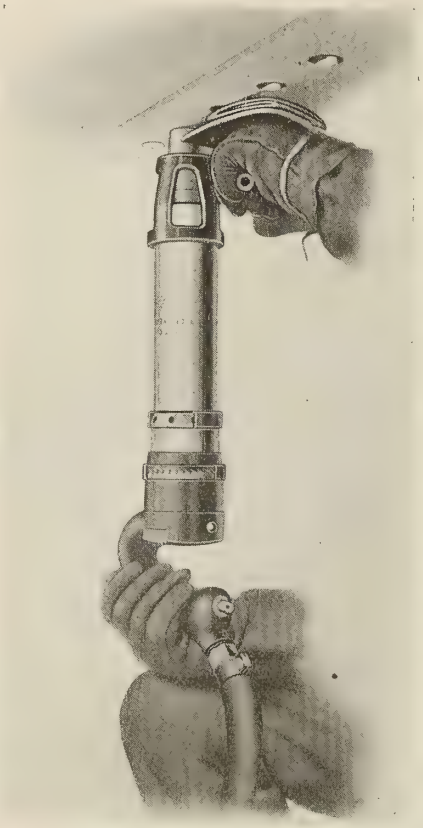
The device fits over the muzzle of most makes and sizes of riveting hammers, to provide the riveter a firm, full hand control of the hammer without grasping the heated cylinder. It is designed with the intention of providing an unobstructed view of the work, as



Device for Hand Control of Hammer Without Contact With Heated Clyinder

well as to eliminate the possibility of jammed or squeezed fingers. Because of this adjustability left-handed and overhead work may be accomplished readily.

On chipping and calking hammers it is claimed that the grip provides a comfortable hand-hold with perfect control at any working angle, as well as protection against the accidental shooting of the chisel and the danger of injury to the hand should the chisel slip from the work.



Device in Use on Close Work

The New Duntley Lock for Air Hammers

Instead of the three parts usually found in locking devices for air hammers, the Duntley lock, recently brought out by the Duntley-Dayton Company, Chicago, Ill., consists of two parts only —a spring locking ring and a lock pin. The new lock, the company claims, is more effective than the old as applied to both the riveting and chipping hammers. It can be easily manipulated when it is necessary to unlock and unscrew or adjust the handle, and is in line with the other improvements which are being made by the Duntley-Dayton Company to simplify the construction of air tools.

Development and Specialization of Rod and Wire Welding Fillers

Vast strides in automobile, railroad and ship construction within the past two years have brought the matter of welding to a position of great importance, for all of the steel industries are dependent on this art. Seven years ago welding, as carried on at present, was practically unknown, and the progress made since then has been largely due to the improvement in fillers.

Sometime ago the Central Steel & Wire Company, of Chicago, caused tests to be made on various steel alloys in the metallurgical laboratories and forge, in order to determine whether the existing use of a single filler for all purposes might be improved. Preliminary investigations led to the adoption of the present convenient form of wire and rod fillers. This was an important change, but the subsequent discovery that wire must be treated differently for electric welding and acetylene welding was even more so.

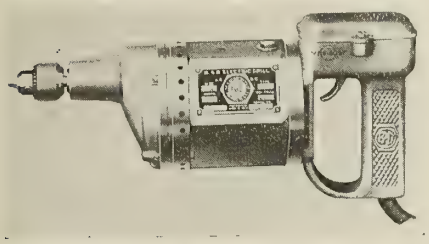
Swedox was the first special welding material supplied, accomplishing this differentiation. Then it was determined by experiment that a filler used successfully in welding nickel steel, for example, was very inefficient in the case of vanadium steel. Gradually fillers were treated so that they might be used to advantage with practically any steel alloy, until at present there are eight special welding materials available.

Testing Power Losses in Gear Operation

A number of tests have recently been made by a new electrical apparatus perfected by C. M. Allan, professor of hydraulic engineering at Worcester Polytechnic Institute, Worcester, Mass., for detecting small power losses in the operation of gears. The best results were obtained with a mixture of heavy oil and flake graphite. This bears out the claim of the Joseph Dixon Crucible Company, Jersey City, N. J., that flake graphite properly combined with oils and greases, because of its ability to build up microscopic irregularities in gear surfaces, forms a tough film of graphite, which prevents metal to metal contact.

Portable Electric Trigger Switch Drills

The Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore, Md., has recently placed two new one-hand drill models on the market. These drills, of 3/16-inch and ¼-inch sizes, are operated by the pistol grip and trigger switch method—a patented feature previously obtainable only in the larger size drills. Through this



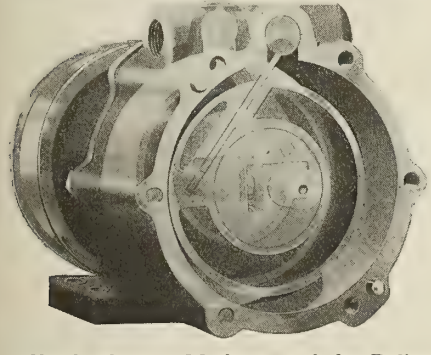
Black & Decker Portable Trigger Drill

mechanism the current is controlled by the trigger without the necessity of changing the position of the hand which holds the drill. This arrangement has the additional advantage of preventing the breakage of drill bits, so often caused by sagging of the drill when the hand of the operator is withdrawn to turn the switch.

These models are furnished with 1/6-horsepower motors with series compensated windings, and may be operated on any current from direct to 60-cycle alternating. Cooling is accomplished by the circulation of air through the housing by means of a vane impeller mounted on the armature shaft.

The Rollway Pump

The accompanying illustration shows the simple construction of the new "Rollway" pump now offered to the trade by the Michigan Machine Company, Detroit, Mich. The working parts



Sketch Showing Mechanism of the Rollway Pump

consist of two rollers which rotate eccentrically in the pump chamber. Since the entire motion is rolling, the inventors claim that wear caused by the scraping of working parts is eliminated. The pump is self-priming; it may be operated at a height 10 feet above the liquid, either water or oil, and under these conditions will prime itself without the use of valves.

This pump may be operated at speeds ranging from 100 to 600 revolutions per minute, upside down or right-side up, and at any point on a machine where its application is most convenient. Either side of the pump may be used for intake or outlet. Where it is necessary to maintain a constant flow in a given direction, regardless of the rotation of the pulley, a pump equipped with reverse valves will be furnished. Standard pumps are furnished with controlling spring to develop 25 pounds pressure at 200 revolutions per minute, 40 pounds pressure at 420 revolutions per minute, etc. Pumps can also be furnished with springs to develop either higher or lower pressures, or without springs where very high pressures are required.

Colonel Watkins Becomes American Manager of Estier Bros. & Company

Col. Robert M. Watkins has assumed the American managership of Estier Bros. & Company, France, one of the oldest and largest steamship agents and stevedores in Southern Europe. When the United States Government in 1918 opened a naval base at Marseilles, and required quick action in unloading vessels carrying supplies, Estier Bros. & Company became the principal contractors. Even at their best, however, European methods of handling ships are not up to the high standard employed by Americans, and it is the intention of Colonel Watkins, as soon as he has contracted for sufficient American business, to make an extended tour of French and North African ports to install American supervision there.

Colonel Watkins, a Spanish-American War veteran, was director of operations at the United States Army Base located at Marseilles. As a civilian he has been engaged in the stevedore business, and for many years was superintendent of the Osaka, Shosen & Kaiska work on Puget Sound. The New York office of the company is at 2 and 4 Stone street.

BUSINESS NOTES

Watson K. Mawby, formerly naval architect for the Electric Welding Company of America, has become associated with the S O S Welding Corporation, 235 Sixth street, Brooklyn, New York, in a similar capacity. The company is now building several all welded steel boats for harbor work.

F. S. Eggleston, Jr., has been appointed manager of the New England branch of the Keller Pneumatic Tool Company, Grand Haven, Mich. The offices will be located at 259 Franklin street, Boston, Mass.

N. E. McClelland & Company, Ltd., naval architects, marine engineers and ship brokers, has located a new office at 2-4 Stone street, New York. Benjamin P. Young will be associated with Messrs. McClelland & Company, Ltd.

The Northwest Engineering Works, Green Bay, Wis., has opened a New York office, Room 539, 149 Broadway. A. C. Rimmer will act as representative here.

A firm of consulting mathematicians has been organized, with offices at 500 West 116th street, New York City, to extend to the industrial world the resources of modern pure and applied mathematics. The organization will be known as Dantzig, Pfeiffer & Ritt. Dr. Dantzig, a graduate of the University of Paris and of the Ecôle Supérieure d'Aéronautique et de Construction Mécanique, has taught at Columbia and at the Indiana University, and during the war was in charge of the mathematical work of the instrument section of the United States Ordnance. Dr. Pfeiffer, of Stevens Institute of Technology and Columbia University, has instructed in mathematics in Harvard, Princeton and Columbia. Dr. Ritt, also a Columbia man, was connected for three years with the Naval Observatory and taught mathematics at Columbia. He was one of the chief ballisticians in the United States Ordnance during the war.

Sergeant Paul Mitchell, who was stationed with the Provisional Supply Depot, American Expeditionary Forces, France, during the war, has returned to Chicago, and resumes his position as traveling representative for the Independent Tool Company, 600 West Jackson Boulevard, Chicago, Ill.

The John E. Hand & Sons Company, Haddonfield, N. J., has announced the opening of a store for the sale of nautical instruments at 114 West Plume street, Norfolk, Va., under the management of Edwin W. Lodge.

At a recent meeting of the board of directors of the Foundation Company, 233 Broadway, New York, Franklin Remington was elected chairman of the board, John W. Doty was made president of the company, and H. J. Deutschbein, vice-president and general manager.

Chicago Pneumatic Erects Office Headquarters in New York

The Chicago Pneumatic Tool Company plans moving its general offices from Chicago to New York, and toward this end is erecting an office building at 6-8 East Forty-fourth street, New York City.

The structure, built by the Westinghouse-Church-Kerr Company of combination steel, brick and limestone, will comprise, initially, ten stories, all to be occupied by the company. The ground floor is to be a permanent exhibition room, containing a display of the Chicago Pneumatic Tool Company's products. In conjunction, a completely equipped service station will be maintained. The new building is to be ready for occupancy early in 1920, at which time the transfer will be effected.

Brooklyn Polytechnic Institute Offers Evening Courses in Marine Engineering

The Brooklyn Polytechnic Institute, 85-99 Livingston street, Brooklyn, N. Y., has just announced that courses in marine engineering, ship drafting and yacht design will be opened the last of this month for those desiring instruction in these branches. These courses are laid out especially to meet the demand for professionally trained men in this field. They give students comprehensive training, so that on entering a shipyard or ship-drawing office they will understand what is required of them and how to proceed in accomplishing it.

The training is also valuable for those engaging or expecting to be engaged in any shipping activity, such as vessel brokerage, forwarding, or the business of shipping agencies or steamship companies, since the instruction includes calculation of carrying capacity, fuel requirements per voyage, economical repair and drydocking, as well as a thorough knowledge of the design, construction, repairs and operation of all types of vessels and the machinery installed upon them. The numerous shipyards in New York offer opportunities for students seeking employment or desiring to supplement their theoretical work with practical training.

The course in yacht design should prove especially valuable to yachting enthusiasts, since it will give them an expert's knowledge of all kinds of yachts, both sail and power, with the relative merits or demerits of various types and the reasons therefor. It will enable them to design and draw up complete a sailing yacht or motor boat of their own choosing under skilled guidance. This course includes points of naval architecture not taken up in the ship drafting course. It is arranged to be taken alone, but students of the marine engineering and ship drafting courses may also take it to advantage. Additional and advanced courses leading to the degree of Bachelor of Science in naval architecture and marine engineering may be offered later.

PERSONALS

Holder A. Evans, president of the Baltimore Dry Docks & Shipbuilding Company, left for Europe August 14 to be absent from this country until October. Mr. Evans expects to make a thorough survey of shipbuilding plants in Great Britain, Norway, Sweden, France, Denmark and Italy.

Antonia C. Pessano, chairman of the board of directors of the Great Lakes Engineering Works, and a director of the American Bureau of Shipping, has been elected a director of the American Merchant Marine Insurance Company.

Winthrop L. Marvin has been engaged by the American Steamship Association for special work to be carried on by that association.

Capt. J. H. Rinder, nautical advisor of the Pacific Mail Steamship Company, and C. W. Cook, formerly chief traffic manager of the American-Hawaiian Steamship Company in San Francisco, have formed the partnership of Rinder & Cook, to conduct a business of marine surveying, brokerage and steamship operation on California street, San Francisco, Cal.

Louis C. Eitzen, formerly general manager of the August Meitz Corporation, New York, is now associated with the Pittsburgh Filter & Engineering Company as vice-president and general sales manager, with offices located at 280 Broadway, New York City. For six years previous to his affiliation with the August Meitz Corporation in 1917,



Louis C. Eitzen, Vice-President of the Pittsburgh Filter & Engineering Company

Mr. Eitzen was sales and electrical engineer of the Standard Underground Cable Company, Pittsburgh, Pa. He has also been associated with the electrical Testing Laboratories of New York City and with the Bristol Instrument Company, Waterbury, Conn. He is an engineer graduate of Cooper Union and a law and accounting graduate of Pace Institute. In addition to this technical training in the engineering and business professions, including several years in very close study of oil engine engineering practice, Mr. Eitzen has recently specialized in matters relating to organization and administration, particularly along manufacturing and commercial lines, which will now be applied to the development of the oil engine business of the Pittsburgh Filter & Engineering Company.

W. L. Parrish has been appointed general freight and passenger agent for the Baltimore Southern Navigation Company. J. K. Tunis will relieve C. J. Rivenbark as Baltimore agent when Mr. Rivenbark becomes publicity manager of the company.

A. Matthew, prominent in Seattle, Wash., shipping circles, has become one of the owners of the Universal Shipping & Trading Company.

E. A. Plunkett has resigned his position with the Shewan Drydocks to become manager of Ira S. Bushey & Sons, Inc., Brooklyn, N. Y.

Paul H. Macneil, resident engineer of the United States Shipping Board Emergency Fleet Corporation stationed at Savannah, Ga., has resigned his position to become associated with the Crandall Engineering Company, Boston, Mass., to be engaged in drydock construction work. Mr. Macneil's first work in this new capacity will be undertaken at the Bruce drydock, Pensacola, Fla.

Commander S. M. Robinson, United States Navy, has been appointed fleet engineer of the Pacific fleet, and will be stationed on the United States battleship *New Mexico*.

B. E. Meurk, chief engineer of the Ship Division of the Tennessee Coal & Iron Railroad Company, will be located at the company's works in Fairfield, Ala., in connection with the Chickasaw Shipbuilding Company, Mobile, Ala.

Karl B. Roebling, president of John A. Roebling & Sons Company, has been elected a director of the American Ship & Commerce Corporation, the merger formed by the William Cramp & Sons Ship & Engine Building Company and the Kerr Navigation Company.

W. F. Gibbs, designer of the new 1,000-foot vessels which the United States Shipping Board plans to build, has sailed for Europe. It is reported that Mr. Gibbs will consult with leading British naval architects.

P. A. S. Franklin, president of the International Mercantile Marine Company, has returned to Europe to complete routine business of the company which was interrupted by his return to America in connection with the British ship deal.

OBITUARY

Daniel J. Kennedy, works manager of the Kennedy Valve Manufacturing Company, died on June 16.

George Elmer Miles, treasurer of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., died at his home at the Sherman Square Hotel, New York, on August 20. Mr. Miles, after preparing for West Point, entered his business career as a newspaper reporter on the *Tribune*. For a long time he was intimately associated with Horace Greeley, traveling with him on political tours. More recently he served as the secretary of Colin P. Huntington, and through this connection became associated with the Newport News Shipbuilding & Dry Dock Company.

Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIP CONTRACTS

The Albina Ship & Engine Company, Portland, Ore., it is said, has received a contract to build four 6,000-ton steel ships at that yard for Scandinavian interests.

The Aluminum Company of America, Pittsburgh, Pa., is building through one of its subsidiary companies four-steel vessels of 4,000 tons capacity. The company plans eventually to build a fleet of ten vessels to carry ore from the British, French and Dutch Guianas. The company will also secure barges and towboats for river service between St. Louis and Baton Rouge.

The American Shipyards, Lake Washington, Wash., has received word from Christofer Hannevig, Inc., New York, to complete the two 3,250-ton motorships upon which work had been previously suspended.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., will construct the battleship No. 54, to be named the Massachusetts, at its Fore River plant. This ship, which is the last of the authorized battleships to be contracted for, will have a displacement of 43,200 tons.

This company has also received an order for two 12,600-ton steel tankers to be constructed at the company's Fore River plant for the Standard Transportation Company, 26 Broadway, New York. The company has also received a contract for one 11,400-ton ore carrier from the Ore Steamship Company 111 Broadway, New York. The vessel is one of the fleet of ten which will be built for this service, as part of the $50,000,000 development authorized by Charles M. Schwab, for Sparrow's Point.

The Chickasaw Shipbuilding Company, Mobile, Ala., has received a contract to build 8 10,000-ton cargo carriers for the United States Steel Corporation.

The Downey Shipbuilding Corporation, Staten Island, N. Y., holds a contract from the Coastwise Transportation Company, Boston, Mass., to build a cargo steamer of 7,800 tons deadweight. The vessel will be 396 feet overall, 381 feet between perpendiculars, molded beam 52 feet, depth 30 feet.

The East Coast Fisheries Company, 7 Wall street, New York, has placed an additional order for three steel trawlers with the Portland Shipbuilding Company, South Portland, Me. The engines will be furnished by the Portland Company, Portland, Me.

The Federal Shipbuilding Company, Kearney, N. J., has received a contract to build 12 10,000-ton cargo carriers for the United States Steel Corporation.

The Longbeach Shipbuilding Company, Long Beach, Cal., has received a contract from the California & Mexican Steamship Company for a 300-foot motorship with accommodations for fifty passengers.

The Los Angeles Shipbuilding & Dry Dock Company, Los Angeles Cal., it is reported, has received a reinstatement on five vessels. The previous contract called for 8,000-ton vessels. Vessels of 12,000 tons, it is said, are now to be built.

The Manitowoc Shipbuilding Company, Manitowoc, Wis., has received a contract from the Atlantic Fruit Company, 61 Broadway, New York, for two vessels of 3,200 deadweight tons.

Weaver & Son, Orange, Tex., is constructing two 80 by 24 feet barges for the Gulf Refining Company. The **Garden City,** a towboat of the D. W. Ryan Towboat Company, Houston, Tex., is also being rebuilt at this yard.

PROSPECTIVE SHIP CONSTRUCTION

Electrically Propelled Vessel of 15,000 Tons.—The White Flyer Steamship Line, San Francisco, Cal., W. S. Scammel, general manager, plans to build a 24-knot passenger vessel of 15,000 tons displacement which will be propelled by electric power. The estimated cost of the vessel is announced as $1,500,000.

Ferryboat, Wilmington, N. C.—The city of Wilmington, N. C., is in the market for a ferryboat. The commissioners have not been able to obtain a vessel already built, and so are planning to construct the boat in a New York shipyard. About $40,000 will be spent. W. P. McGlaughon, W. E. Yopp and Addison Hewlett represent the committee in charge of the work.

Ore Carriers of 4,000 Tons.—The Aluminum Company of America, Pittsburgh, Pa., plans to operate 10 ore carriers of 4,000 tons capacity. Contracts for four of these vessels have already been let.

Ship Canal Dredges.—The Universal Shipbuilding Company and the Midland Bridge Company, Houston, Tex., have submitted bids for the construction of four dredges to be used in widening and deepening the Houston Ship Canal, as provided by Government appropriation funds.

Steamers.—The St. Helens Shipbuilding & Dry Dock Company, St. Helens, Ore., it is reported, will build several steamers. A recent fire at this yard inflicted a $15,000 damage to the steamer Colindo on the ways.

Stern-Wheel Steel Towboat.—The Mississippi River Commission, first and second districts, Custom House, Memphis, Tenn., wishes to secure a stern-wheel steel towboat. Proposals will be received until September 2.

Car Barges and Passenger Steamers.—The Canadian Pacific Railroad, according to a statement made by Captain J. W. Troup, manager of the British Columbia coast service, is considering the building of several car barges and passenger steamers.

River Packets.—The Liberty Transit Company, which operates a fleet of packets on the Ohio River, plans to place additional boats in the service. No specifications have been issued.

Steamships for Mexican and South American Service.—The Ocean Mail Steamship Company, San Francisco, Cal., organized by Oliver J. Olson to carry on trade between San Francisco, Mexico and South America, plans to build three or four new vessels for the service.

Twenty-Knot Passenger Vessel and Several Smaller Vessels.—The Matson Navigation Company, San Francisco, Cal., we are advised, will place orders in the near future for one large 20-knot passenger steamer and several smaller passenger and freight steamships of slower speed. W. P. Roth is the vice-president and general manager.

NEW SHIP CONCERNS AND SHIPYARD EXTENSIONS

Boiler Works, Menasha, Wis.—The Menasha Boiler Works, Menasha, Wis., was recently incorporated, with a capital of $50,000, to engage in general boiler and structural business. William J. Hess, William A. Bruce and Arthur Strange are the incorporators.

Coaling Dock, Southport, N. C.—The Liberty Shipbuilding Company, Lewis R. Ferguson, general manager, Wilmington, N. C., is constructing a $300,000 coaling station on the waterfront at Southport, N. C.

Concrete Shipbuilding Company, San Francisco, Cal.—The Concrete Barge & Ship Company, San Francisco, Cal., has been organized by R. R. Culp and William Hodge to build barges. Construction will be in charge of N. C. Nicolsen, who was superintendent of the San Francisco Shipbuilding Company. The engineering problems of the new company will be handled by Earle Russel, who also comes from the San Francisco Shipbuilding Company, and gained further experience in the construction of the 7,500-ton tankers now being built on Government Island in the Oakland estuary. The company has a site on the estuary.

Construction Buildings and Shop Equipment, Bay City, Mich.—Following the fire at the Defoe Boat & Motor Works, Bay City, Mich., on July 23, the site was immediately cleared and new machinery put into operation. New buildings are now being erected and the plant will be working as usual in a short time.

Drydock, Champlain, Que.—About $207,000 is being spent in building a drydock at Champlain, Que.

Drydock, Prince Rupert, B. C.—The Prince Rupert Dry Dock & Engineering Company, Prince Rupert, B. C., is constructing a 20,000-ton drydock, 600 feet long. It will be built in three sections, which will be capable of independent action.

Marine Railway, Chelsea, Mass.—The Winnisimmet Shipyard, Inc., Chelsea, Mass., has begun the construction of a 3,500-ton railway drydock, including retaining walls and wharves which will be used in conjunction with it. This is the eighth drydock of the railway type to be constructed in Boston harbor. The Crandall Engineering Company, East Boston, Mass., is the designer and builder of the drydock.

Outfitting Dock, Suisun Bay, Cal.—The Pacific Coast Shipbuilding Company, Suisun Bay, Cal., is adding a 250-foot extension to its fitting-out wharf. The addition will bring the total length of the wharf to 700 feet.

Ship Equipment Firm, Brooklyn, N. Y.—The Neptune Boiler & Machine Works, Inc., Brooklyn, N. Y., has been organized with a capital of $50,000 for building ocean vessels. J. C. Wilcox, F. B. Johnson and M. J. McDade, 434 Forty-ninth street, Brooklyn, are the incorporators.

Ship Machinery Company, Toronto, Can.—The H. A. Wood Manufacturing Company, has been incorporated by Melvin G. Hunt, and George H. McArthur, 12 Spaulding avenue, Toronto, Ont., with a capital of $1,000,000, to manufacture valves and ship machinery.

Railway Drydock, Norfolk, Va.—Work will soon be begun upon the 4,000-ton marine railway which the Colonna Marine Railway Corporation, Norfolk, Va., is constructing. The dock has been designed by the Crandall Engineering Company, East Boston, Mass. This company will also handle the construction work.

Ship Operation Corporation, Montreal, Canada.—The Robert Redford Company, Ltd., Montreal, Quebec, was recently incorporated, with a capital of $1,000,000, to engage in the operation of ships. Aubrey H. Elder, Felix W. Hackett, D. Burley-Smith and others are the incorporators.

Ship Repair Company, New York.—The Harbor Boat Repairing Corporation, New York, was recently incorporated, with a capital of $5,000. C. E. Malmo, J. C. Duke and B. B. Mead, 1999 Washington avenue, New York, are the incorporators.

Ship Salvage Company, Montreal.—The British Wrecking & Salvaging Company, Montreal, Que., was recently chartered to build ships, boats, etc. The company is capitalized at $2,000,000. Richard T. Heneker, Henry N. Chauvin, Harold E. Walker and others are the incorporators.

Ship Salvage Corporation, Bridgeport, Conn.—The Argonaut Salvage Corporation, Bridgeport, Conn., has been incorporated under the laws of the State of Maine, with a capital of $10,000,000, by Simon Lake and associates to carry on marine salvage work. The company has perfected apparatus which permits the salvage of sunken ships or their cargoes at a depth of at least 100 feet without the use of divers, etc.

Shipbuilding Company, Boston, Mass.—J. H. Bogart & Son Shipbuilding Company, Boston, Mass., was recently organized, with a capital of $25,000. Wm. M. Bogart, E. M. Simmonds, M. I. Brooks and others are the incorporators.

Shipbuilding Company, Beaufort, N. C.—A new shipbuilding company, to be known as the American Shipbuilding & Dock Corporation, has about completed a shipyard two miles south of Beaufort, N. C., for the construction of concrete barges. About $500,000 has already been invested in equipment at this plant. R. C. Horne, Beaufort, is president of the corporation; W. E. Richardson, vice-president of the Beaufort Bank, is treasurer, and F. C. Heard is manager.

Shipbuilding Company, Camden, N. J.—The American Shipyard Company, foot of Division street, Camden, N. J., has been incorporated, with a capital of $100,000, to engage in the building of ships, etc.

Shipbuilding and Shipoperating Company, Wilmington, Del.—The Ballymena Company has been incorporated at Wilmington, Del., with a capital of $100,000, to build and operate boats. The incorporators are W. F. O'Keefe, George G. Steigler and J. W. Dodwell, of Wilmington.

Shipyard, Belfast, Ireland.—Harland & Wolff, Belfast, Ireland, have just completed a new shipyard on the Musgrave Channel, where the first vessel to be laid is of the N class, built on the straight frame fabricated system similar to other 6,500-ton vessels built in English yards. The new yard will have six building berths and a frontage of 900 feet.

Shipyard, Charleston, S. C.—The Charleston Dry Dock & Ship Repair Company, it is reported, will locate a large repair plant and shipyard at Remley's Point, Charleston, S. C. This company has been incorporated under Delaware laws, with a capital of $2,225,000. Robert M. Reid, 24 Broad street, New York, the incorporating lawyer, reports that details will soon be available regarding the project.

Shipyard, Portland, Me.—The Job Shipyard Corporation, Portland, Me., has purchased the yard of the Machias Ship Construction Company, which was equipped by the United States Shipping Board Emergency Fleet Corporation. On the four ways which are available, the company has begun the construction of two vessels. The yard is also equipped for the repairing of all classes of wooden vessels. The following men are in charge of the company: W. C. Job, president; R. Job, vice-president; John R. Fox, second vice-president; Robert Badcock, treasurer; Glenn R. Eudaley, secretary.

Shipyard Extension, Groton, Conn.—The New London Ship and Engine Company, Groton, Conn., has built a $25,000 addition, 60 by 70 feet, which will be used in the further production of marine engines.

Shipyard Extension, Clyde, Contra Costa County, Cal.—The Pacific Coast Shipbuilding Company, Suisun Bay, Cal., has completed the city of Clyde, Contra Costa County, Cal., to house the shipbuilders employed at the company's yards.

GOVERNMENT SHIPYARDS FOR SALE

Shipbuilders' Housing Development for sale. St. Helena, Md.—On August 4, bids were closed for the St. Helena housing project, composing 296 houses and a cafeteria building and power house. This development is about ten minutes' trolley run to the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation, Sparrow's Point, Md.

Wooden Shipyard for Sale, Cornwells, Pa.—The Traylor Shipbuilding Corporation, Cornwells, Pa., has been put up for sale by the United States Shipping Board. At this yard were constructed eight 3,500-ton vessels of the Ferris type. These yards front on a deep wide basin and extend at the rear to the Pennsylvania Railroad, covering an area of about 80 acres. Concrete shops and wooden and concrete housing accommodations are built upon the premises. There is abundant possibility for enlargement of the yards.

Wooden Shipyard, Tools and Equipment for Sale, Raymond, Wash.—Bids will be received until September 10, at the office of the district manager, 607 Securities building, Seattle, Wash., or at the office of the manager of the Shipyard's Plant Division, 140 North Broad street, Philadelphia, Pa., for the sale of the corporation's shipbuilding plant at Raymond, Wash., operated by Sanderson & Porter. Tools and equipment are included.

EQUIPMENT

Derrick Crane, Mobile, Ala.—The city of Mobile is installing a derrick crane on the municipal docks to handle the steel containers which are being built for the Warrior River barge canal system.

Freight Handling Equipment, St. Louis, Mo.—C. E. Smith, Railway Exchange Building, St. Louis, Mo., may be addressed concerning the installation of freight handling equipment at the St. Louis municipal terminals.

Line Throwing Guns and Outfits.—On July 30, the Shipping Board reopened bidding on 900 line throwing guns and outfits, to be taken in lots as required. The guns must be of a type approved by the United States Steamboat Inspection Service. They may be of either steel or bronze.

Marine Engines, Portland, Me.—The Portland Company, Portland, Me., has received a contract to supply the engines for three steel trawlers being built for the East Coast Fisheries Company.

Marine Engines and Auxiliary Equipment, San Francisco, Cal.—The Union Gas Engine Company, San Francisco, Cal., has received a contract to construct eighteen 300-horsepower, four-cylinder, heavy duty marine engines and auxiliary equipment for nine concrete towboats which are being built on the Atlantic coast.

Mechanical Stokers and Turbo-alternator, Charleston, S. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to instal mechanical stokers to cost about $11,000, and a turbo-alternator to cost about $50,000 in the central power plant, Charleston, S. C.

Outfitting Vessels, Providence, R. I.—The Lord Construction Company, Field's Point, Providence, R. I., has received a contract to outfit four 5,000-ton vessels for the Emergency Fleet Corporation. These ships are being constructed at the yards of the Bayles Shipbuilding Corporation, Port Jefferson, L. I.

Steel Containers, Warrior Barge Canal.—Henry de Bardeleben, Federal manager of the Warrior River system, has recently announced that 500 more steel containers have been ordered to handle the 10,000 tons of freight which will soon be carried on the Warrior River barge canal per month.

PROPOSED CONSTRUCTION

Boat and Storage Building, Philadelphia, Pa.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to build a beat and storage building at Philadelphia, Pa. Cranes will be installed.

Drydock, Brooklyn, N. Y.—The Bureau of Yards and Docks, Navy Department,, Washington, D. C., plans extensive repairs of drydock No. 4, New York, to cost about $100,000.

Dry Dock, Victoria, B. C.—The contract will be let in October for the construction of the Esquimalt drydock at Victoria(, B. C., according to a statement by Dr. S. F. Tolmie, M. P., Victoria.

Drydock Pontoons, Savannah, Ga.—The Terry Shipbuilding Corporation, Savannah, Ga., is planning to construct two more pontoons to form the complete sectional drydock to be operated at Savannah. The company has just completed the construction of its fourth pontoon.

Harbor Improvements, Fort William, Ont.—The Dominion Government is about to let a contract for extensive harbor improvements at Fort William, Ont., to cost about $200,000. R. C. Desroches, Department of Public Works, Ont., is the secretary.

Harbor Improvements, Glace Bay, N. S.—About $50,000 will be spent in harbor improvements at Glace Bay, N. S. R. C. Desroches, Department of Public Works, Ottawa, Ont., is secretary.

Harbor Improvements, Port Dover, Ont.—About $50,000 will be spent in the improvement of the harbor at Port Dover, Ont. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Harbor Improvements, Quebec, Que.—About $56,000 will be spent in improving the Charles river, at Quebec. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Harbor Improvements, St. John, N. B.—Harbor improvements will be made at St. John, N. B., to cost about $55,800. R. C. Desroches, Department of Public Works, Ottawa, Ont., is the secretary.

Lumber Piers, Fairfield, Md.—The Weyerhaeuser Timber Corporation, Everett, Wash., will construct four large lumber piers on a 76-acre site at Fairfield, Md. James E. Long, the Baltimore representative, may be addressed, care of George R. Willis, 213 Cortland street, concerning the project.

Ore Terminal, Baton Rouge, La.—The Aluminum Company of America, Pittsburgh, Pa., plans to build a large ore terminal at Baton Rouge, La. Barges carrying ore and freight to and from St. Louis will transfer their cargoes to ocean vessels at this point.

Pattern Shop, Norfolk, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning the erection of a pattern shop at Norfolk, Va., to cost about $500,000.

Pier, Avondale, La.—The Oceanic Repair Company, Avondale, New Orleans, La., plans to build a 1,000-foot pier to be used in the exportation of oil.

Pier and Warehouse, Wilmington, N. C.—The Fisheries Products Company, Wilmington, N. C., is planning to construct a small warehouse and dock on Cape Fear river, to cost about $10,000. George W. McKown is the superintending contractor.

Piers, New York City.—The Sinking Fund Commission has finally authorized the building of fourteen new piers at a cost of from $15,000,000, to $20,000,000. This construction includes the building of eight piers between Arrieta and Canal streets, Staten Island., and four piers south of Canal street, at Stapleton, S. I. These piers will be 1,000 feet long, 125 feet wide, with 300 foot slips, each covered with a one-story steel shed. Piers 3, 4 and 5, North River, two of which will have to be purchased from private owners, are also to be rebuilt. The leases will run for ten years with the privilege of renewal for a like period at an annual rate of 7½ percent of the cost of construction for each pier.

R. P. Betts, deputy chief engineer, Department of Docks, New York City, has announced that the handling equipment would consist of cargo masts only. Plans for the construction of some of these piers are nearing final approval.

River Terminal, Memphis, Tenn.—The River Terminal Commission, Memphis, Tenn., is planning extensive river terminals to facilitate the handling of freight on the Warrior Barge Canal. Funds to the amount of $270,000 are now available for this work. Authorization has been granted for a referendum vote on a $500,000 additional bond issue. W. S. Schoulz, Chamber of Commerce, Memphis, Tenn., is the consulting engineer.

Shipyard Addition, Fairfield, Md.—The Union Shipbuilding Company, Fairfield, Md., plans to make substantial additions to its plant.

Shipyard Extensions, Bremerton, Wash.—In the naval appropriation bill the Senate approved the following items for the Puget Sound Navy Yard: Railroad extension, $50,000; 20-ton floating crane, $50,000; grading, filling and sea wall, $350,000; additional storage building at the naval magazine, $40,000; power plant at the naval magazine, $15,000; quarters for female nurses at the naval hospital, $40,000.

Terminal, Havana, Cuba.—The Atlantic, Gulf and West Indies Steamship Lines, 11 Broadway, New York City, is drawing up tentative plans to build a large terminal at Havana, Cuba, to cost from $2,000,000 to $3,000,000.

Terminal Development, Baltimore, Md.—F. W. Kasselbaum, Jr., connected with the Baltimore Dry Dock & Shipbuilding Company, Baltimore, Md., has developed plans for the building of a terminal on a 200-acre tract of land owned by Frank A. Furst. Construction includes the erection of warehouses, piers and well-planned railroad facilities. Initial expenditure includes $100,000 for bulkhead, $825,000 for covered pier, $1,824,000 for two warehouses with $400,000 for approaches, $126,000 for pier equipment and additional expenditure for railroad heating plants, locomotives, etc. Although the preliminarry cost of the enterprise is estimated at $5,000,000 to $7,000,000, the ultimate plans provide for eight piers and thirty-two buildings, and will entail the expenditure of at least $30,000,000.

Timber Breakwater, Depot Harbor, Ont.—About $34,000 will be spent in reconstructing the timber breakwater at Depot Harbor, Ont. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Valve Shop, Readington, Pa.—The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., is planning to erect a large valve shop at Readington, Pa. The plant, when completed, will give employment to more than 1,000 men.

Warehouse and Freight Handling Machinery, St. Louis, Mo.—C. E. Smith, Railway Exchange Building, St. Louis, Mo., may be addressed concerning the extension of the municipal docks at that city, including the building of a warehouse 400 by 200 feet, the building of a warehouse extension and the installation of additional freight handling equipment.

Wharf, Bass River, N. S.—About $21,000 will be spent in the building of a wharf on Bass river, N. S. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Wharf, Francois du Sud, Que.—About $30,000 will be spent in rebuilding the wharf at Francois du Sud, Que. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Wharf, Quaco, N. B.—About $22,000 will be spent in rebuilding a wharf at Quaco, N. B. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Wharves, Anse aux Gascons, Que.—About $36,000 and $34,000 will be spent in the construction of two wharves at Anse aux Gascons, Que. Address E. Lafleur, Department of Public Works, Ottawa, Ont.

Wharves, Galveston, Tex.—The Gulf Refining Company, Pittsburgh, Pa., and Port Arthur, Tex., plans to construct docks and wharves near Ninth street, Galveston, Tex.; the construction includes a slip of 28 feet draft, storehouses and storage tanks.

INTERNATIONAL

Marine Engineering

Volume XXIV OCTOBER, 1919 Number 10



Fig. 1.—Sparrow's Point Dry Dock With 7,000-Ton Steel Ore Vessel in Dock. View Taken from Bay

Twenty-Thousand-Ton Floating Dry Dock

Bethlehem Shipbuilding Corporation, Ltd., Places In Operation at Its Sparrows Point Plant Huge Dry Dock Designed by William T. Donnelly

THE new floating dry dock recently completed by the Bethlehem Shipbuilding Corporation, Ltd., at their Sparrow's Point plant, Sparrow's Point, Md., is a good example of what is modern in dry dock construction. It is of the pontoon type, making use of individual wooden pontoons and continuous side wings of steel, and is electrically operated from a control house on the shore. It has a capacity of 20,000 tons, is 600 feet in length by 130 feet wide and is suitable for accommodating vessels with a draft of 24 feet.

Twelve wooden pontoons are employed, each independent of the other, but attached to the side wings in such a manner that the wings act as continuous girders extending the full length of the dock. Each pontoon is divided into two compartments by a watertight bulkhead extending lengthwise through its center. The pumping machinery consists of twenty-four centrifugal pumps, direct-connected to electric motors vertically mounted on the decks of the side wings in watertight casings, as shown in the accompanying illustrations, and remotely controlled from a control house located on the shore.

One pump is located in each compartment of a pontoon, and electrical connections are such that by means of individual switches the pumps of any pontoon can be operated independently of those of the others, or by means of a master switch the pumps of all twelve pontoons can be operated simultaneously. This feature provides means whereby the stresses in the boat being docked may be equalized by utilizing the individual control and bringing a decreased or increased upward pressure to bear on certain pontoons, as required.

In addition to the centrifugal pumps, which are used

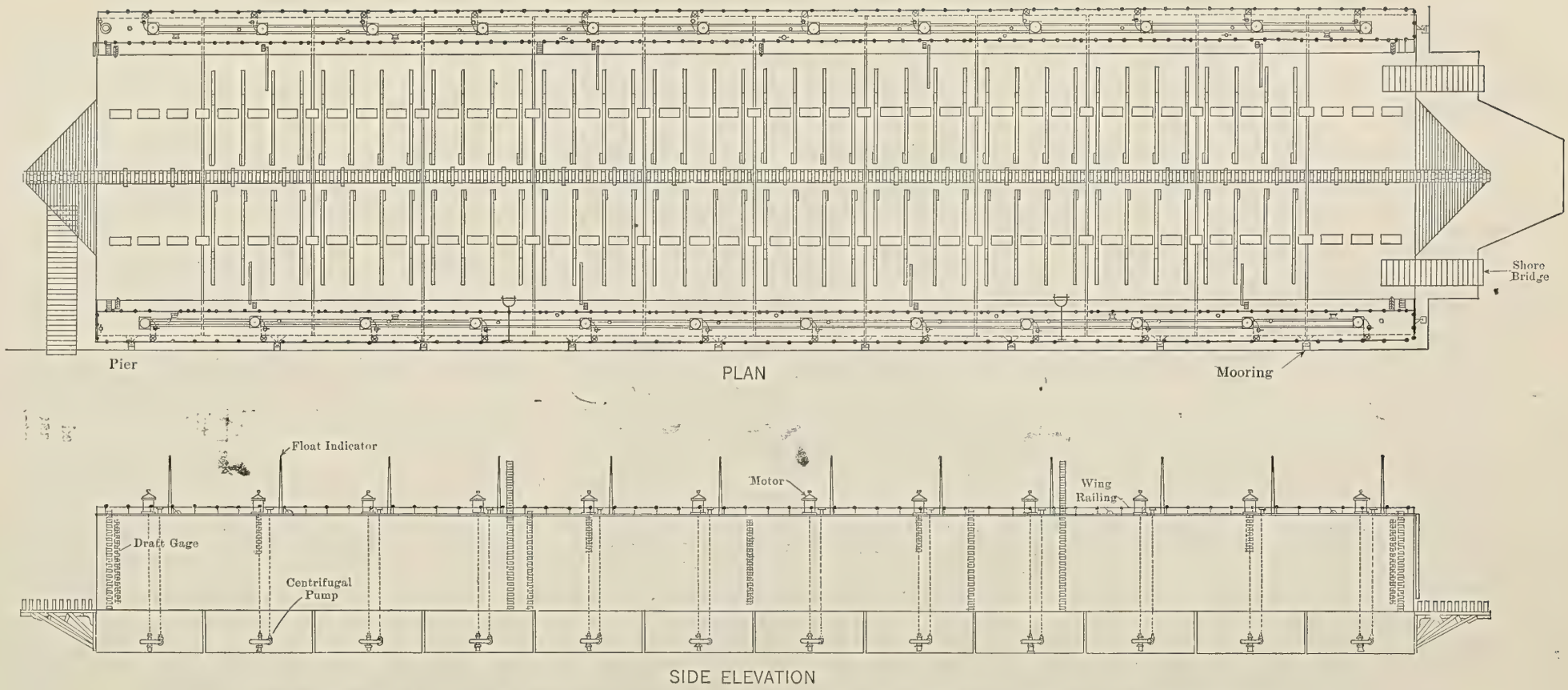
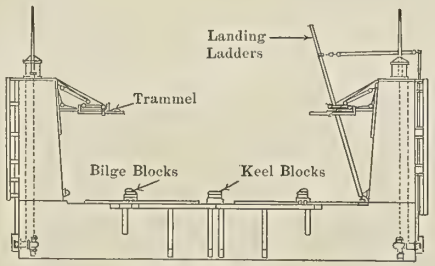
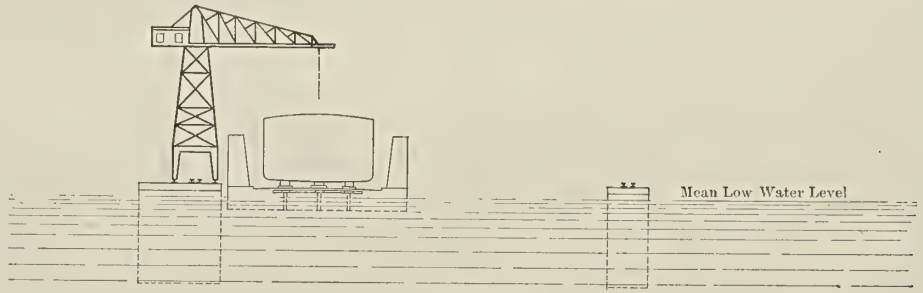


Fig. 2.—Plan and Elevation of 20,000-Ton Floating Drydock at Sparrow's Point Plant of Bethlehem Shipbuilding Corporation, Ltd.



END ELEVATION
Fig. 3



SECTION A-A
Fig. 4

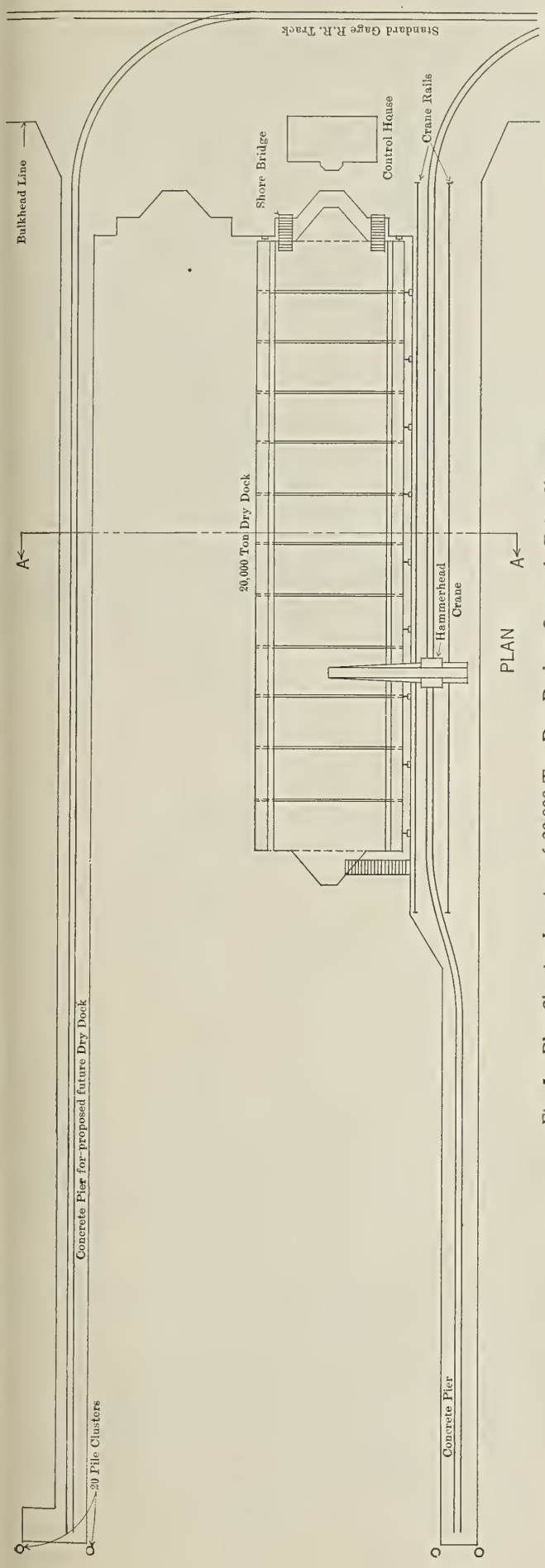


Fig. 5.—Plan Showing Location of 20,000-Ton Dry Dock at Sparrow's Point Shipyard

for emptying and thereby raising the pontoons, each pontoon is provided with two gate valves for filling and submerging. The gate valves are located in each end of the pontoons and so arranged that the same ports are used in filling the pontoons and in pumping the water out. Operation of the valves is by hand from hand-wheels located on the decks of the wings.

Wings

The wings are 40 feet high and 15 feet wide at their bases. They are of watertight construction and communicate at their bases with the compartments of the pontoons. In order to aid in the submergence of the dock, ballast in the form of timber properly distributed is placed in the upper part of the wings. This timber ballast also serves the purpose of a float to prevent the submergence of the dock below the depth desired.

In the construction of the piers, provision was made for a future dry dock to be built on the north side of the present one, as shown in the plan view, Fig. 5. The piers are of concrete with pile foundations and extend out into the bay a distance of 1,260 feet. The dock is moored to the south pier and to the bulkhead by means of moorings of steel construction anchored in the concrete about 16 feet back from the pier and bulkhead lines.

An electrically operated hammer-head crane with a capacity of 22 tons at a radius of 40 feet is located on the south pier to take care of any work to be handled in the dock. The crane has a maximum radius of 90 feet, a minimum radius of 12 feet and a lift of 90 feet.

Time Required for Docking Vessel

Observations taken in a number of cases show the following to be the average time required to complete the various operations in docking a vessel under ordinary conditions:

Average time to submerge dock from 18 feet on draft gage to dock level, or a total of 22 feet, allowing 4 feet for keel blocks	25 minutes
Average time required for towing vessel in dock, centering same, adjusting lines, etc.	25 minutes
Average time to raise the vessel in dock up to deck level of dock, or 22 feet	43 minutes
Total time for docking	1 hour 33 minutes

It is to be noted that the above figures include the time required to open and close valves, start motors, etc., in each case, as required. The actual rate of submerging and raising after the dock has started and is under way is approximately one foot per minute—that is, with all gates open when submerging and with gates closed and all motors operating at full speed when raising.

During the first month of operation, April, 1919, a total of 15 vessels were docked at Sparrow's Point, aggregating a gross tonnage of 45,000.

The Sparrow's Point dock was designed by William T. Donnelly, consulting engineer, New York City, and constructed by the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation.

The Sea-Going Tug Basswood

THE sturdy design and construction of the sea-going tug *Basswood*, recently built for the Government by the Bayles Shipyard, Inc., Port Jefferson, Long Island, N. Y., will enable the vessel to fulfill the requirements and take the highest class of either the American Bureau of Shipping or Lloyd's Register of Shipping, although the

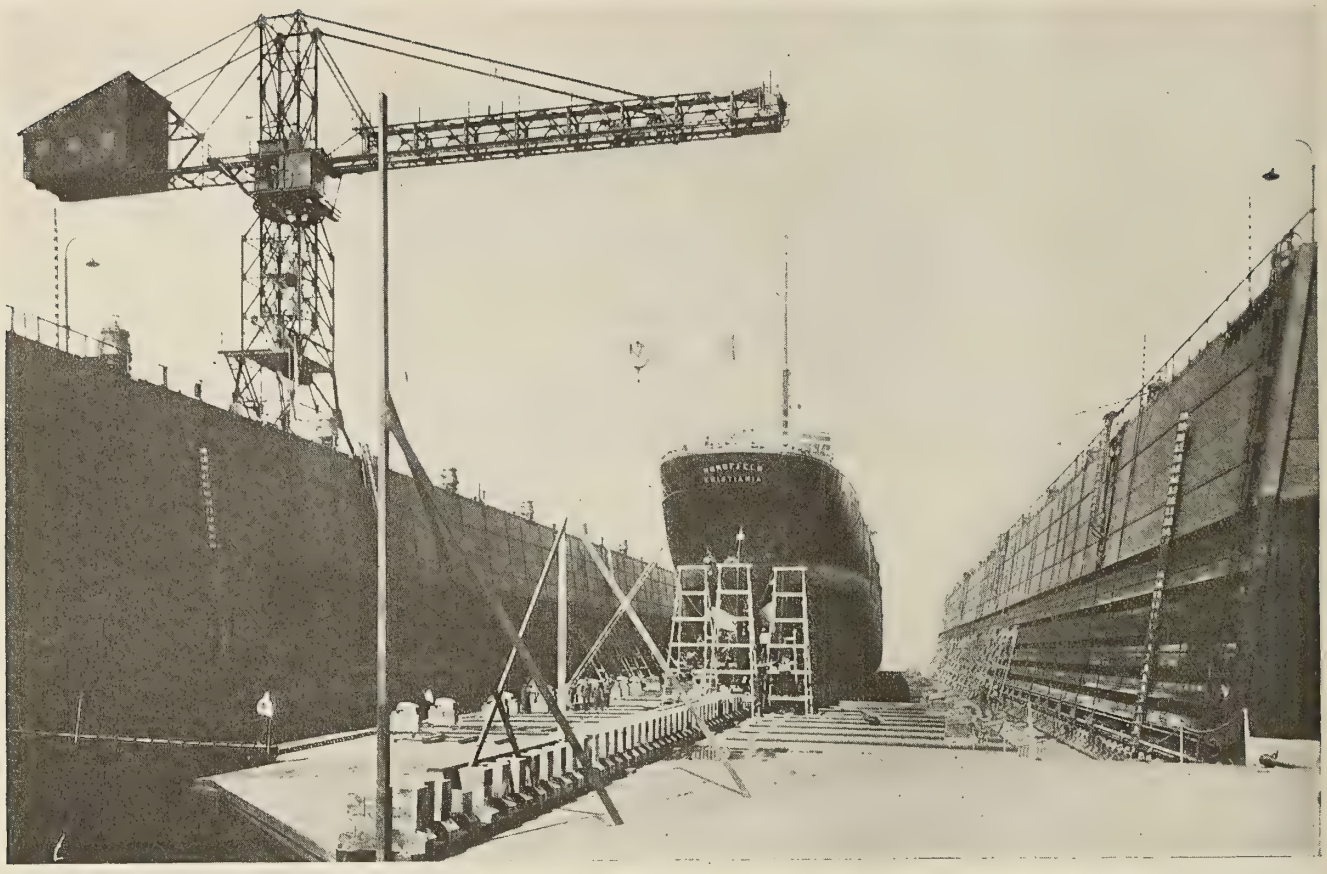


Fig. 6.—Sparrow's Point Dry Dock With Vessel in Dock. Viewed from Shore, Showing Hammerhead Crane

specifications did not require construction to meet any classification society's rules.

The principal dimensions of the *Basswood* are as follows:

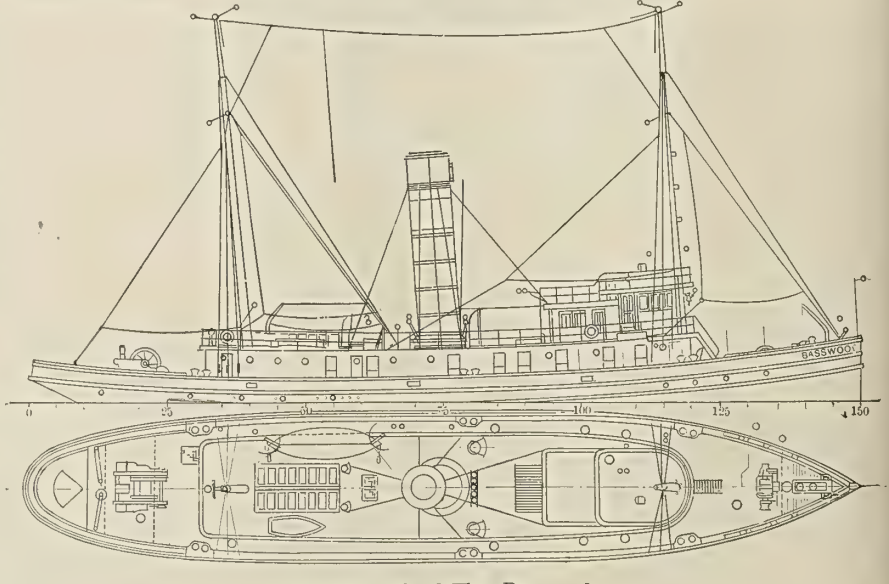
Length, after side of stem to after end of main deck	150 feet 0 inches
Length, forward side of stem to after side of rudder post	141 feet 3½ inches
Beam, molded	27 feet 6 inches
Depth, molded	16 feet 8 inches

The hull is of steel with bar keel, single bottom and solid floor construction throughout. The frames and beams are of bulb angle sections. Special ice protection is provided at the forward end by means of intermediate frames. The hull is divided into six compartments by means of three watertight and two screen bulkheads.

The deck house is of steel, above which is a wooden pilot house with a wooden house aft of the same for the captain's quarters. Rooms are arranged in the deck house for the chief engineer, assistant engineer, mate, oilers, steward and wireless operator, and, in addition to these, the galley, officers' mess, radio room and spare room and two toilets. Quarters for the balance of the crew are provided below the main deck forward of the coal bunkers. Access to this space is provided by a companionway in the forward end of the deck house.

The steering gear is steam-operated, the steering engine being placed on the lower deck aft of the engine casing. Control is by means of steel shafting and brass gears from the wheel in the pilot house.

An approved steam brake windlass is fitted on the lower deck forward, of sufficient power for handling 1,500-pound anchors. The deck fittings include six large side



150-Foot Steel Tug *Basswood*

bitts and two towing bitts, one forward and one aft, and other necessary chocks, cleats and fairleads.

The life-saving equipment consists of one 20-foot metallic lifeboat and one 10-foot wooden working boat, both stowed on the top of the deck house and handled by the usual type of rotating davits.

The vessel is rigged with two wooden pole masts and with fore staysail, foresail, main staysail and mainsail.

The main propelling engine is of the inverted-cylinder, vertical, direct-acting, three-cylinder, triple-expansion type, with cylinders 17 inches, 25 inches and 43 inches diameter, having a stroke of 30 inches. The high-pressure cylinder is at the forward end and the low-pressure aft. The engine is provided with steam reversing gear and a hand-turning gear.

The thrust block is of cast iron of the adjustable type with 12 yokes, 7 for ahead and 5 for astern.

The stern tube is of cast iron, bolted to the after peak bulkhead and secured to the stern post by a shoulder and cast steel nut. The bearing consists of a composition bushing fitted with lignumvitae bearing blocks.

Auxiliary machinery in the engine room consists of independent air pump, circulating pump, feed pump, fire pump, sanitary pump and filter box and feed water heater.

Electric current is generated by a 7-kilowatt generator and is used for general lighting and to operate the searchlight.

Steam for the main engine and auxiliaries is supplied by two coal-burning boilers of the Scotch marine type. The boilers are 11 feet 6 inches inside diameter and 12 feet long over the heads. Each boiler is fitted with two corrugated Morrison furnaces 46 inches inside diameter and a single combustion chamber. The boilers are built for a working pressure of 180 pounds per square inch.

Feed water for the boilers is carried in the forward and after peak tanks and coal in a cross bunker forward of the boiler room.

Ventilation of the engine and boiler rooms is provided by large cowl ventilators, and the engine room is further ventilated and lighted by a large wooden skylight operated from the upper engine room grating.

The smoke stack is double and extends about 35 feet 6 inches above the top of the deck house. The diameter of the inner stack is 57 inches and the outer 90 inches.



Fig. 1.—84-Foot British Wooden Drifter



Fig. 2.—British Steel Trawler

Drifters and Trawlers

THE Anderson Company of Canada, Montreal, Can., has recently negotiated a contract with the British Government for the purchase of approximately sixty steel trawlers and eighty-nine wooden steam drifters. These vessels were used during the latter part of the war for mine sweeping and patrol service, but were built on the exact design and general arrangement of the British North Sea trawler and drifter, with the view to putting them in the fishing industry at the conclusion of the war.

The entire number of vessels originally contracted for was not completely finished until last summer, and none of the vessels is over one year and a half old. The following is a list of the builders of the vessels and the number of vessels built by each firm:

Drifters

Canadian Vickers, Limited	26
Montreal Harbor Commissioners	4
Leclair & Sons, Sorel, Que.	6
Sorel Shipbuilding & Coal Company	8
Dominion Government Shipyard, Sorel	3
Jas. Sheppard & Sons, Sorel, Que.	3
Davie Shipbuilding & Repairing Company	50
	100

Trawlers

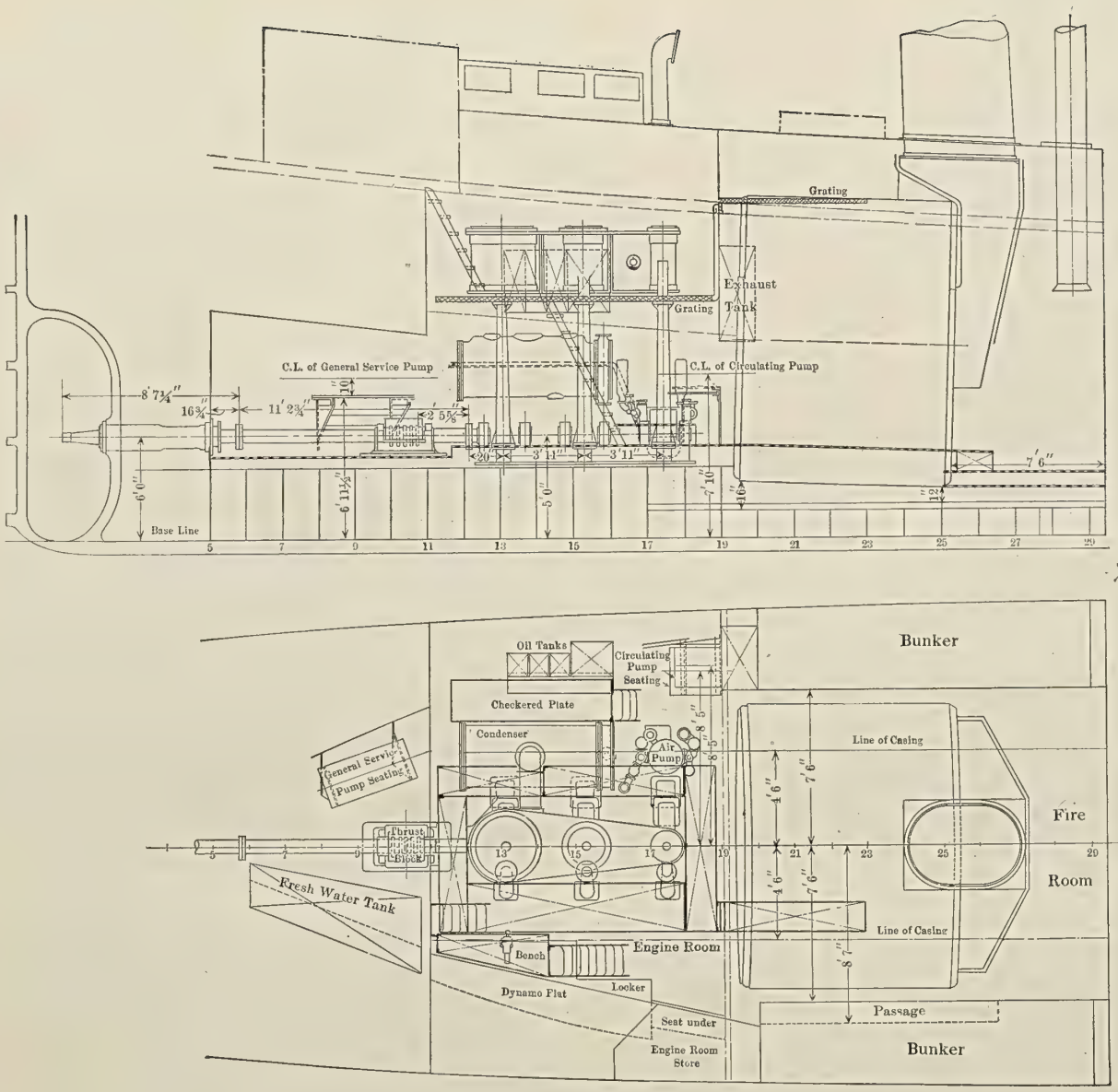
Canadian Vickers, Limited	11
Dominion Government Shipyard, Sorel	6
Kingston Shipbuilding Company	6
Polson Iron Works	4
Thor Iron Works	2
Collingwood Shipbuilding Company	8
Port Arthur Shipbuilding Company	14
Davie Shipbuilding & Repairing Company	6
Tidewater Shipbuilders, Ltd.	3
	60

Wooden Steam Drifter

The drifters are built of wood with a length of 84 feet, a breadth of 19¼ feet, and a draft aft of 9 feet.

These vessels are fitted with compound surface condensing engines having cylinders 12 inches and 24 inches diameter and a stroke of 16 inches, designed to indicate about 200 horsepower at 140 revolutions a minute, which gives the vessels a speed of 8½ knots.

Steam is supplied by a multitubular marine type boiler fitted with two furnaces designed for 140



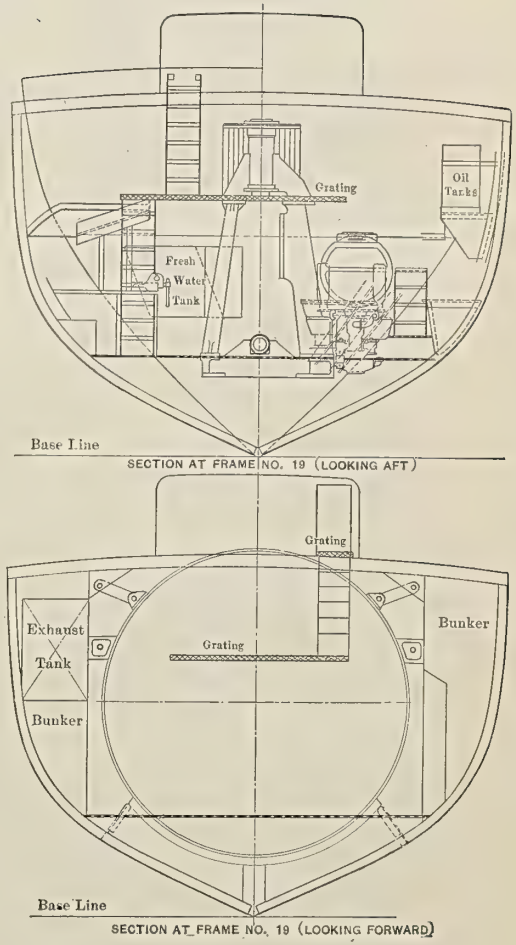


Fig. 3.—Machinery Arrangement of British Steel Trawler

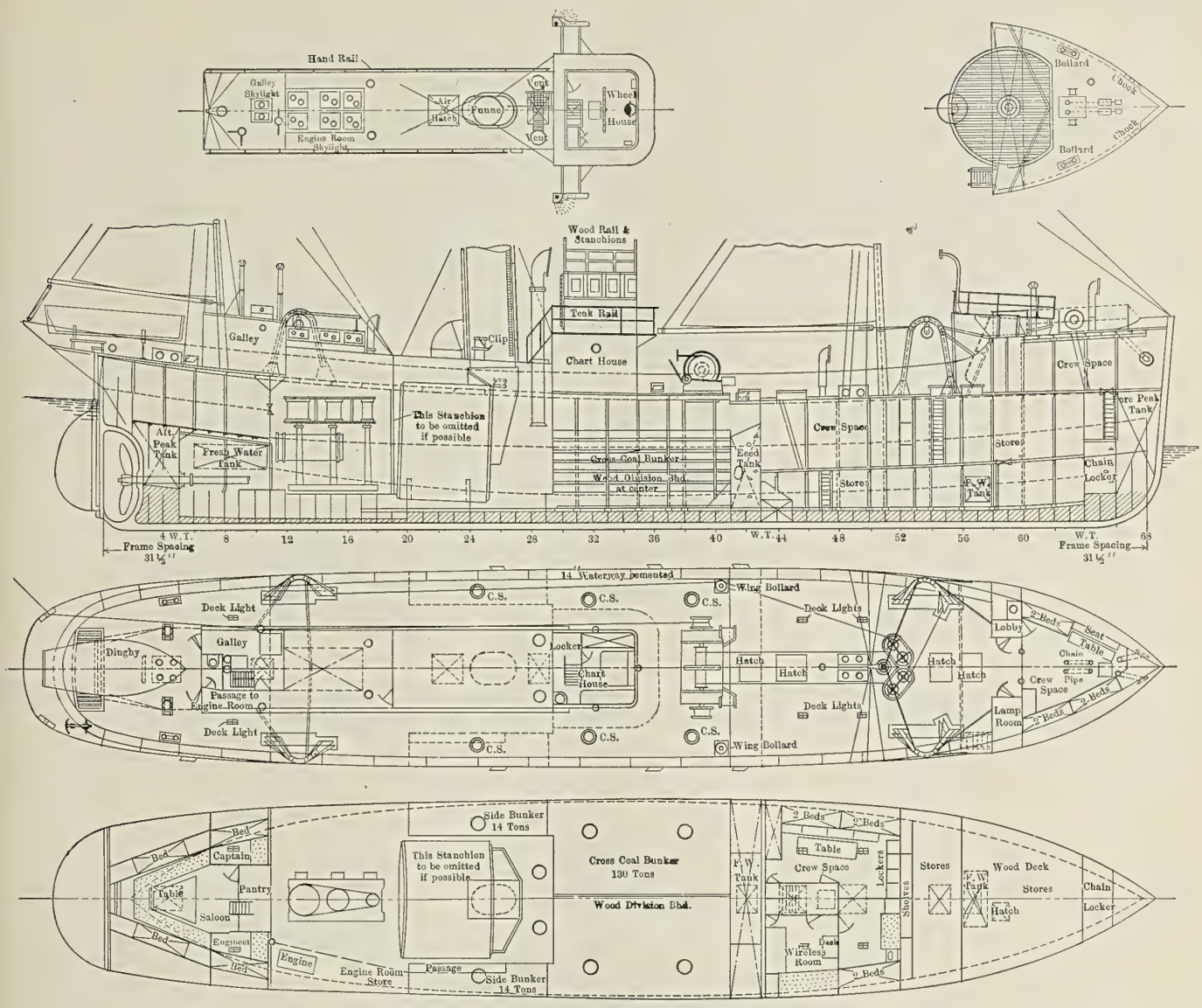


Fig. 4.—General Arrangement Plans of British Steel Trawler

pounds working pressure working under natural draft.

The vessels are arranged in every way similar to the British herring drifters, a very large number of which are continually operating around the British Isles. Accommodation is arranged fore and aft for a crew of 10 men. Steel casings are fitted over the engine and boiler room, the after part of which forms a galley on deck, and the forward part the wheel house.

Coal bunker capacity is provided for 13 tons in side bunkers and 7 tons in a cross bunker. Two large tanks are fitted for supplying fresh water for the boiler.

These vessels are of a thoroughly seaworthy type and are able to proceed to all parts of the world under their own power.

Steel Steam Trawlers

The trawlers are built of steel; length 125 feet, breadth 23½ feet, molded depth 13½ feet. These vessels, when fully loaded and ready for sea, have a draft of water aft of 15 feet.

The machinery consists of triple-expansion engines having cylinders 12¾ inches, 21½ inches and 35 inches diameter by 24 inches stroke, capable of developing about 500 indicated horsepower at 118 revolutions a minute, which drives the vessel a speed of 10 to 11 knots. A separate surface condenser is fitted, also a direct-acting steam reversing engine and the most modern and up-to-date equipment for a vessel of this type. Steam is supplied by a large 3-furnace marine multitubular boiler of 180 pounds working pressure.

The coal bunker capacity is 160 tons, which will allow the vessel to remain at sea for 30 days. Fresh drinking water tanks of 10 tons capacity and feed water tanks of 15 tons are provided and accommodations arranged for 14 men.

The trawlers are fitted with a 7½-kilowatt generator, which serves for lighting the vessel and also for operating the wireless telegraph.

The whole of the fishing machinery is fitted on deck, arranged identically with the best type of British steam trawler. The fish bunkers have a capacity of 6,000 cubic feet.

The trawl winch, which plays an important part in fishing, has cylinders 9 inches in diameter by 14 inches stroke and works at full boiler pressure. The main shaft is of forged steel, 7 inches diameter, and carries two cast-steel barrels with heavy brass bushings and steel sides, each barrel being capable of winding 1,000 fathoms of steel cable. The main driving wheels are of helical cast steel gearing, and the main clutch gear, which engages the barrel, is of cast steel fitted on a square so as to do away with the use of keys. This winch, when complete, weighs over 9 tons.

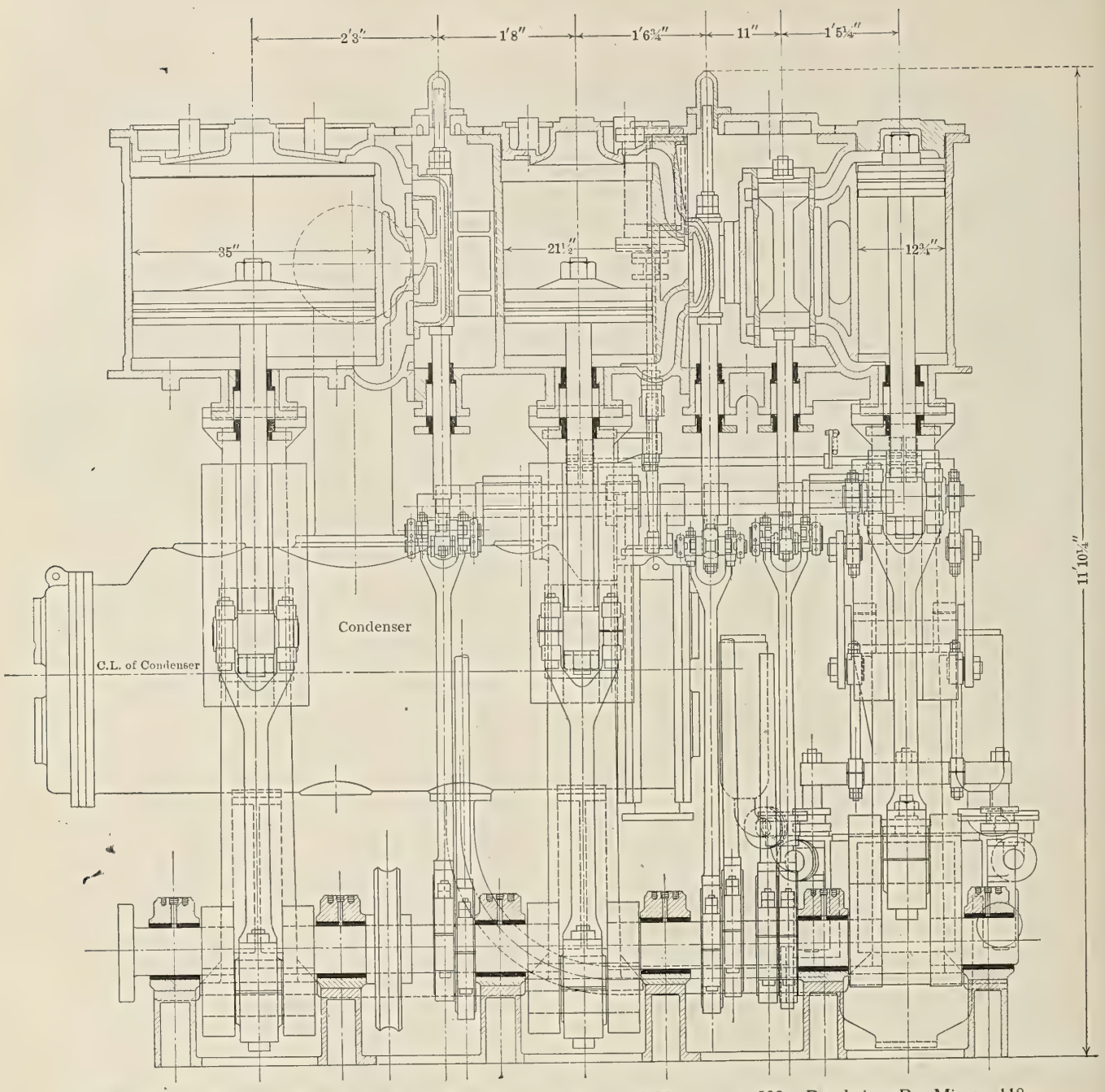


Fig. 5.—Triple Expansion Engine for British Steel Trawler. Indicated Horsepower, 500; Revolutions Per Minute, 118

Rebuilding a Former German Ship at the Panama Canal Shops

REBUILDING of the steamer *Callao,* one of the first of the ex-German interned steamers to arrive at the Panama Canal from Peru, was completed at the Balboa plant and the ship was accepted by the marine superintendent for the United States Shipping Board on April 5, 1919. Prior to her departure from the Balboa plant for New York, via the Canal, this vessel underwent a successful trial trip on April 2, during which her machinery was operated to maximum capacity.

The *Callao,* formerly known as the *Sierra Cordoba,* of the North German Lloyd Steamship Company, was one of four of the best-equipped passenger vessels of this company, plying between Bremen and Buenos Aires. Her principal dimensions are as follows:

Length overall	461 feet
Length of load waterline	438 feet
Beam (molded)	55 feet 9 inches
Depth of hold	38 feet 2 inches
Draft (load)	26 feet 9 inches
Tonnage (gross)	8,226
Indicated horsepower	4,000
Speed (knots)	13
Passenger capacity (1st class)	115
Passenger capacity (3d class and steerage)	1,572
Complement (officers and crew)	179
Number of holds, 4; capacity in cubic feet	364,838

The vessel is fitted with two triple-expansion, three-cylinder, reciprocating engines, driving twin screws, steam being furnished by four marine type Scotch boilers at a working pressure of 200 pounds. The boilers are operated with coal as fuel and are fitted with the Howden forced draft system. The auxiliary machinery consists of the usual pumps, such as feed, bilge and ballast, fire, ash ejector, and sanitary, one Atlas-Werke evaporating and distilling plant, two 60-kilowatt direct-current generator sets, one auxiliary condenser, one Vulcan-Werke ash hoist engine, one Clayton system disinfecting machine, and one Atlas-Werke main and one auxiliary steering

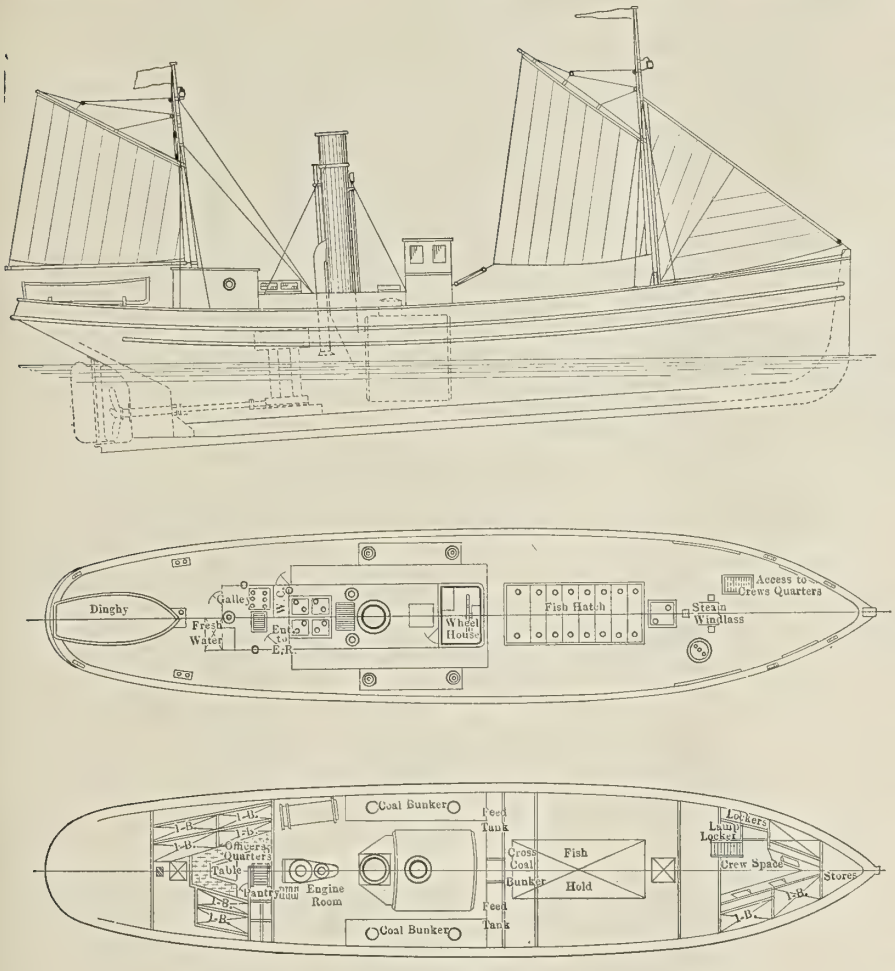


Fig. 6.—Single Screw Wooden Drifter

engine, fitted with a telemotor control gear operated from the bridge.

When this vessel was towed into Balboa by the dredge *Culebra,* which had been dispatched to Peru for this purpose, she was in a very dilapidated and crippled condition, due to her long internment and to destruction wrought by the German crew. Practically no work of repairs had been carried on after Germany's declaration of war, leaving the hull in very poor condition and badly corroded.

Destruction of the Machinery

The destruction of the main and auxiliary machinery was carried out in a most systematic and thorough manner by her former operators. The cylinders of the propelling engines were badly damaged by explosives; the main valves, air pump gear and other miscellaneous brasses and fittings were dismantled and thrown overboard. Important and essential castings of the auxiliary machinery suffered a similar fate by sledge, or could not be accounted for. Especial care was taken to destroy or remove such parts as would render extensive design work necessary for their replacement.

Damage to the Boilers

Water had been removed from the main boilers and fires burned in the furnaces to their full capacity in an endeavor to destroy them. Complete destruction was only prevented by the presence of superheating tubes with which the boilers' flues were fitted. All furnace fittings, however, were destroyed; riveted joints, boiler stays and tubes damaged.

As microscopic, physical and chemical tests on various specimens of boiler plate showed the steel still to be of good quality and unaffected by the heat, the boilers were rebuilt, using new rivets, stays and tubes. The furnace fittings were readily replaced by the Canal foundry. Stacks, uptake, and forced draft duct repairs proceeded simultaneously with those of the boilers. The complete equipment was then lowered in the ship by the crane *Ajax.* As hydrostatic and steam tests of the completed boiler plant indicated excellent workmanship, no delay was experienced in placing the entire machinery department under steam.

Cylinders Patched and Welded

Patches in the meantime had been fitted to the main engine cylinders to replace parts broken, missing or broken beyond repair. Cast iron liners were then inserted in the cylinders to take the pressure strains in the cylinder barrels; damaged ribs and flanges were built up by the electric welding process and machined so that when finished the cylinders were substantially repaired and in serviceable condition.

With the designing of the missing parts, renewing parts from samples and repairing castings by electric and acetylene welding processes, the vessel, taken in a wrecked condition, was repaired and turned over to the United States Shipping Board, equal in all respects to her original design. This work represented approximately 400 separate jobs, all completed within six months after her arrival at the Balboa shops.—*The Panama Canal Record.*

Motorship Being Converted Into Steamship

THE *Glenpool,* formerly the German motorship *Hagen,* is being converted to steam power for the Standard Oil Company of New Jersey at the Mariners Harbor yard of the Staten Island Shipbuilding Company, Staten Island, N. Y. This vessel, as originally built in 1912 at the Fried. Krupp A. G. Germania shipyard for the German-American Petroleum Company, was described on page 207 of the May, 1913, issue of Marine Engineering. The vessel is 400 feet long between perpendiculars, 53 feet molded beam, 32 feet 4 inches depth at side to upper deck, and has a net tonnage of 3,087, a gross tonnage of 5,459, and a deadweight tonnage at summer freeboard of 8,200 tons. Power was formerly supplied by two single-acting, two-cycle Diesel engines capable of developing about 1,500 horsepower each at 140 revolutions per minute, giving the vessel a speed of 11 knots at full load. The new machinery, which has been built by the Staten Island Shipbuilding Company, consists of three single-ended Scotch boilers fitted with Howden's system of mechanical heated draft, two triple-expansion engines capable of developing 1,200 indicated horsepower each at 100 revolutions per minute when supplied with steam at 190 pounds per square inch, and the necessary auxiliaries.

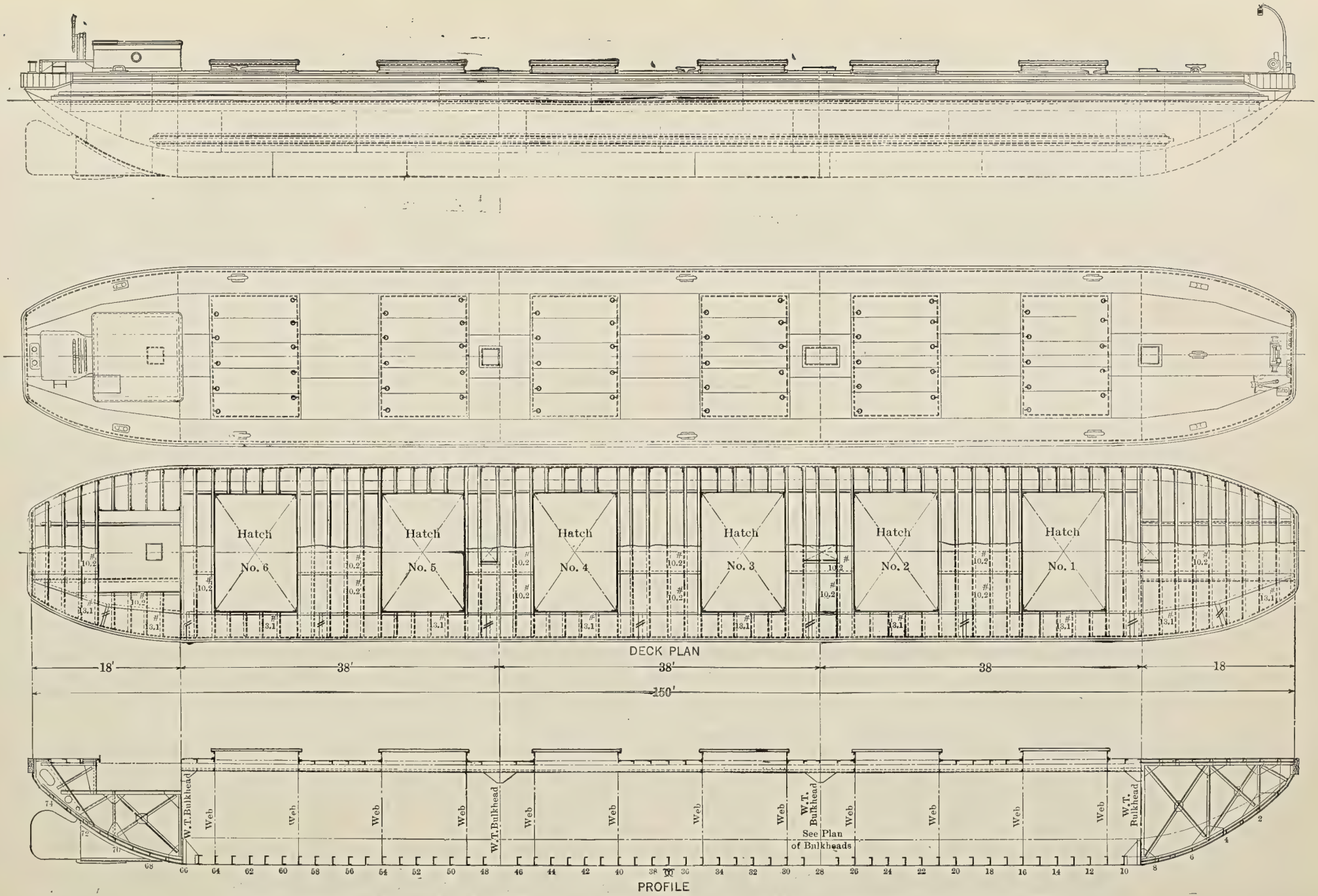


Fig. 1.—Steel Canal Barge: Length, 150 Feet; Beam, Molded, 20 Feet; Depth, 12 Feet; Deadweight Cargo Capacity, 550 Tons

Large Programme of River and Canal Vessel Construction Now Under Way

MESSRS. COX & STEVENS, naval architects, New York, report that at the present time their organization is largely occupied in connection with the Railroad Administration programme covering towboats, self-propelling barges and cargo barges for the various inland waterways.

The following statement covers the various types of vessels now actually under construction, together with the number now under construction of each type, with the builder's name in each case:

150-Foot Canal Barge
(150 feet by 20 feet by 12 feet)
Railroad Administration for New York Barge Canal

	Barges
Dravo Construction Company, Pittsburgh, Pa.	12
Ferguson Iron & Steel Company, Buffalo, N. Y.	16
Terry & Tench, New York City	20
Downing Marine Construction Company, Glen Cove, N.Y.	3
	51

Tunnel Stern River Towboats
(200 feet by 40 feet by 6 feet)
Railroad Administration for Mississippi River

	Boats
Marietta Mfg. Company, Point Pleasant, W. Va.	4
Charles Ward Engineering Company, Charleston, W. Va.	2
	6

Canal and Harbor Steel Barge
(230 feet by 45 feet by 11 feet)
Railroad Administration for Lower Mississippi

	Barges
American Bridge Company, Pittsburgh, Pa.	25
Dravo Construction Company, Pittsburgh, Pa.	15
	40

Tunnel Stern River Towboat
(140 feet by 24 feet by 6 feet)
Railroad Administration for Warrior River

	Boats
Howard Ship Yards & Dock Company, Jeffersonville, Ind.	3

Steel Self-Propelled Barge
(280 feet by 49 feet by 10 feet)
Railroad Administration for Warrior River, etc.

	Boats
St. Louis Boat & Engineering Company, St. Louis, Mo.	4

Steel Self-Propelled Cargo Barge
(149 feet 6 inches by 20 feet by 12 feet)
Railroad Administration for New York Barge Canal

	Barges
Terry & Tench, New York City	12
Dravo Contracting Company, Pittsburgh, Pa.	4
Starr & Bennett, Newberne, N. C.	4
	20

All of these vessels were designed by Cox & Stevens and are being built under their supervision.

150-Foot Steel Canal Barges

The general particulars of the 150-foot steel canal barges are as follows:

Length inside fenders	150 feet
Beam, molded	20 feet
Depth	12 feet
Draft, light—	
Forward	27½ inches
Aft	30 inches
Displacement, light	155 tons
Displacement on 9-foot draft	705 tons
Deadweight cargo	550 tons

These vessels are to be square-ended barges with rounded ends, as shown on the plans (Fig. 1), with a slight sheer at the ends to take up the camber of the beams.

The bilge is cut away as shown on the midship section (Fig. 2). The barges are divided into five compartments by four watertight transverse bulkheads and have three cargo holds with two hatches for each hold. The ends are hung from the end bulkheads by lattice girders as shown on plans. There is a skeg at the after end, to which the rudder is attached, operated by hand gear.

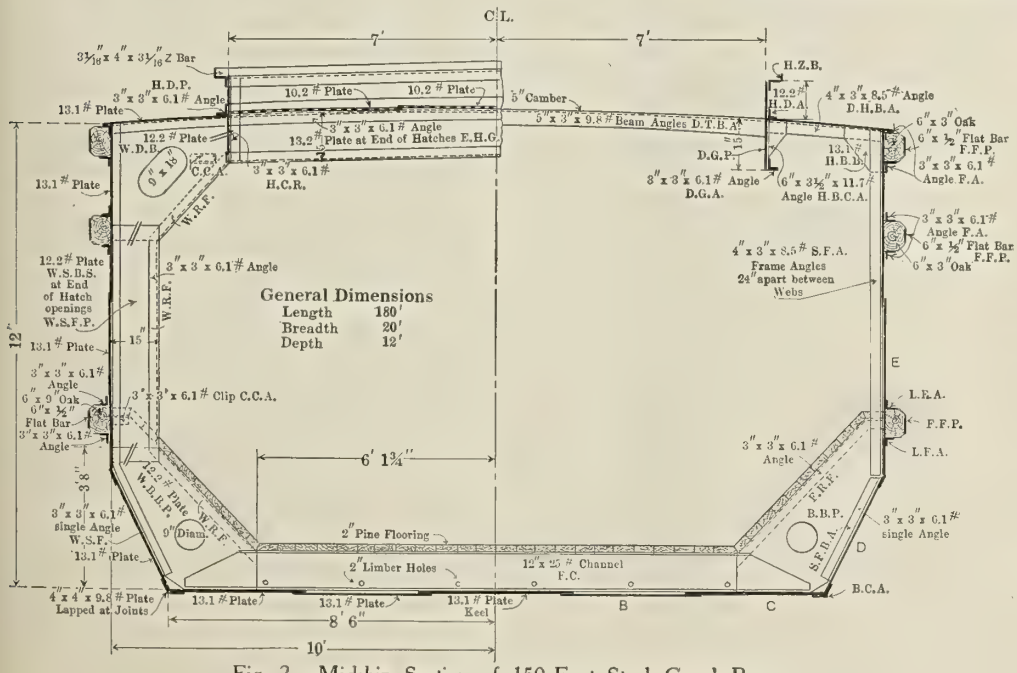


Fig. 2.—Midship Section of 150-Foot Steel Canal Barge

The accommodations for the crew are arranged for in a house at the after end of the barge.

These barges are constructed throughout of steel, the details of the construction having been carefully developed so as to produce a light and serviceable hull. Especial attention is paid to the necessary protecting fenders, and the hull throughout is rigid and sufficiently strong to stand the usage to which these barges will be put.

The hatches, of which there are six in all, are as large as possible, being 14 feet wide by 10 feet in length, with combings and tight covers. Ceiling of 2-inch pine is worked in

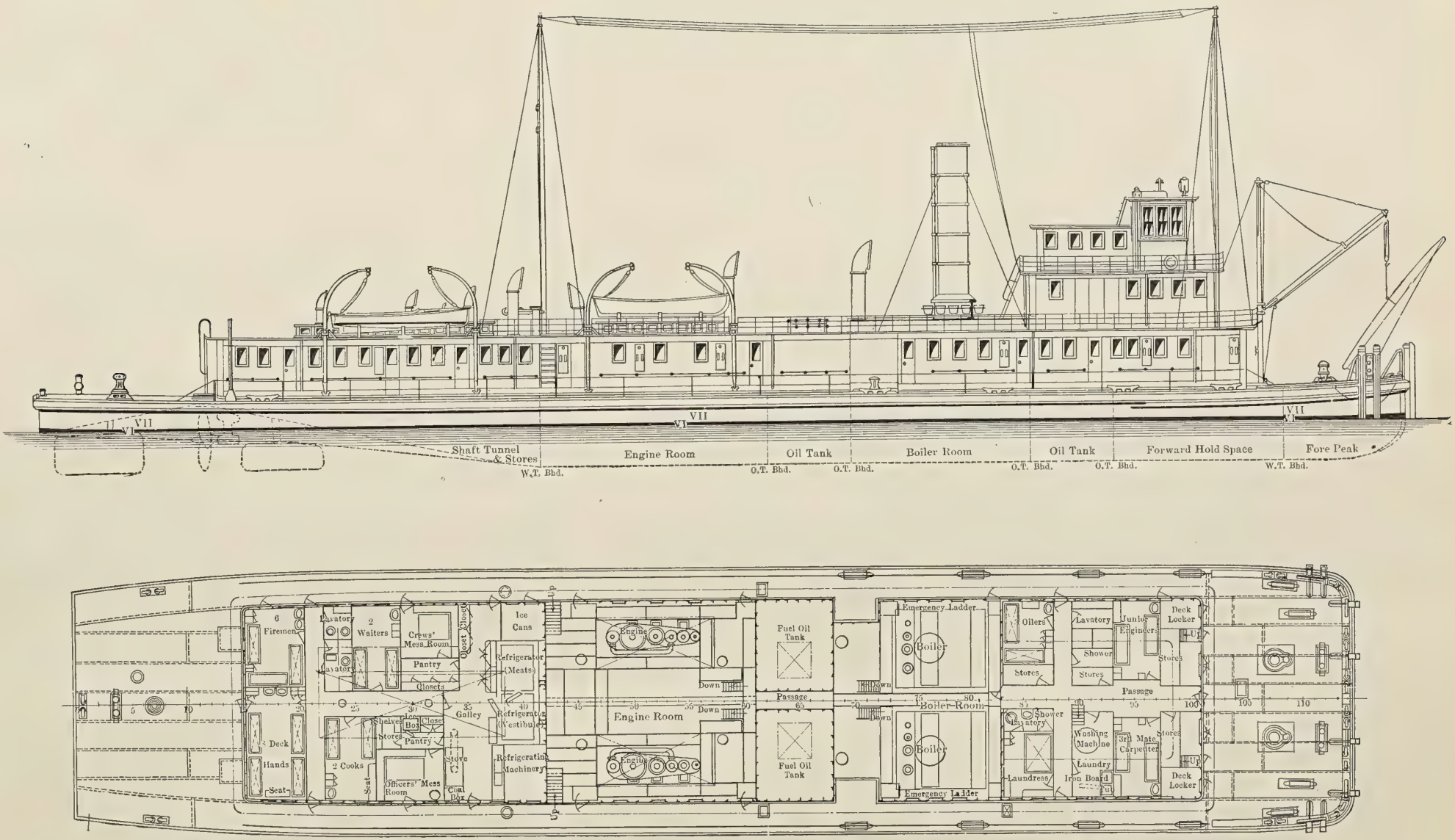


Fig. 3.—Twin-Screw Steel, Tunnel Stern River Towboat. Length, 200 Feet; Beam, Molded, 40 Feet; Depth, Molded, 10 Feet; Indicated Horsepower, 1,800

the holds and carried up on the faces of the bilge brackets.

Fifty-one of these barges are now under construction, and in addition a number of similar barges with propelling machinery are being built.

200-Foot Twin-Screw Steel Tunnel Towboats

The 200-foot twin-screw steel tunnel towboats which Cox & Stevens designed for service on the Mississippi River have the following general dimensions:

Length overall	200 feet
Beam, molded	40 feet
Depth, molded	10 feet
Draft	6 feet

These are single-deck vessels fitted with a continuous deck house about 150 feet long, an upper deck house about 30 feet long, and a pilot house above the upper house about 20 feet long. The main deck house is arranged to accommodate the crew, oilers and firemen, stewards' department, galley, mess-rooms, laundry, lavatories, fuel tanks and machinery spaces. The upper house accommodates the pilot, wireless operator and equipment, engineers, spare rooms, lavatories, officers' saloon and deck lockers. The forward part of pilot house is raised to give the helmsman a clear view in all directions. This house affords accommodations for the captain's stateroom, with enclosed stairs to the lower house.

There are two masts to carry wireless antennae and two small derrick masts forward, together with capstans and heavy bitts and cleats, so located as to facilitate the handling of barges in all positions. The principal towing arrangement is by means of a steel bridle and traveling hook fitted on the upper deck and supported from the after engine room bulkhead by I-beams.

A double bottom is fitted under the engine and boiler rooms for carrying 100 tons of fresh water. Oil fuel is carried in tank compartments located one between the engine and boiler rooms extending to the upper deck and one forward of the boiler room extending to the main deck. The total fuel capacity is about 335 tons.

The vessel is built of steel, all structural material being to the requirements of the American Bureau of Shipping. The general scantlings are shown in the midship section (Fig. 4). Special attention has been given to the arrangement of watertight bulkheads in order to give the vessel the best protection in case of damage from "snags," barges or otherwise. For ease in handling, four rudders are provided in accordance with the best practice for this class of work.

The lines have been developed from an exhaustive study of the type necessary to meet the peculiar conditions of this service, and show a flat section with slightly rounded bilges worked into an easy forebody, and tunnel arrangements aft as clearly shown in the after section (Fig. 3). The sheer is flat, except at the ends.

Special fenders are rigged at the bow to give a bearing for pushing barges either light or loaded without danger of their ends fouling under the overhanging deck of the towboat.

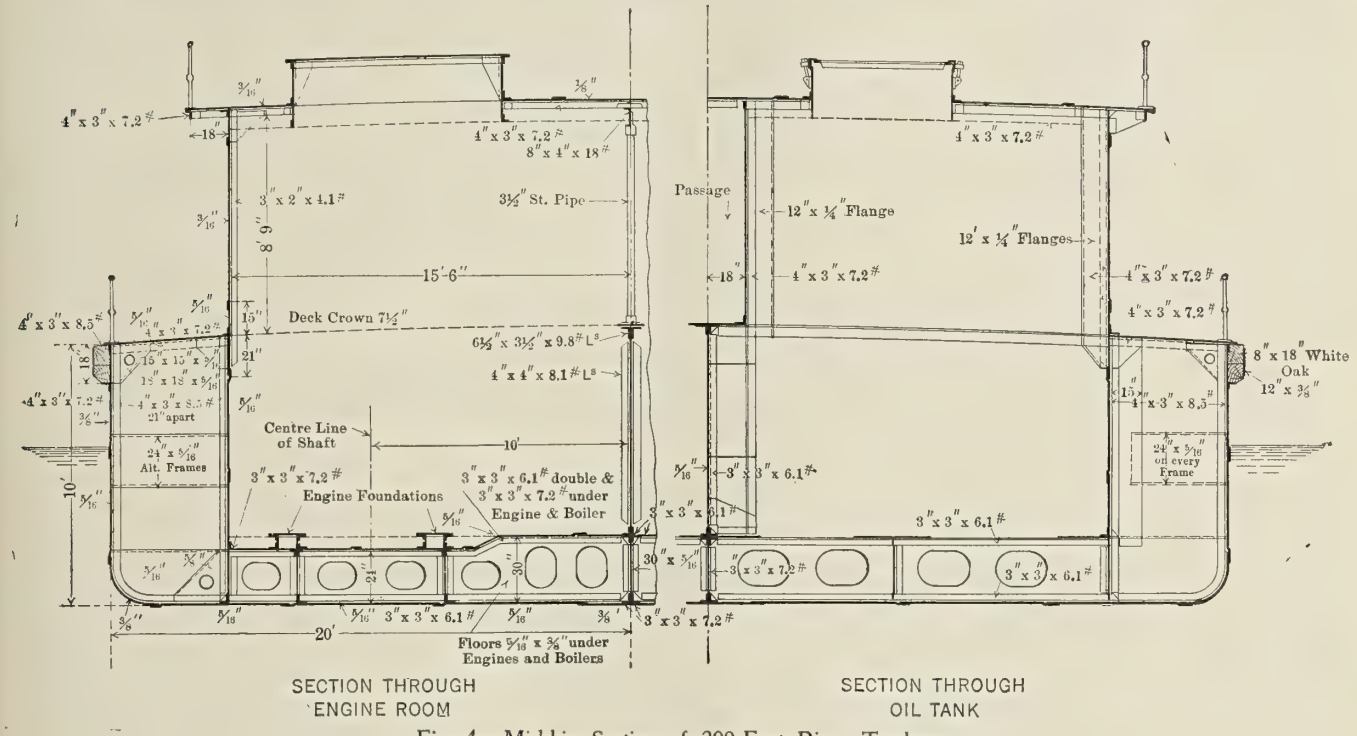


Fig. 4.—Midship Section of 200-Foot River Towboat

The power plant consists of two triple-expansion engines with cylinders 15½ inches by 25 inches by 44 inches and 26 inches stroke, developing about 900 indicated horsepower each. They are to operate condensing with one surface condenser of 2,400 square feet of cooling surface. Steam is furnished at 250 pounds per square inch working pressure by two watertube boilers, oil-fired, having a total heating surface of about 8,000 square feet, and the usual auxiliaries, all independent, are provided.

Two generating sets of 10 and 5 kilowatts respectively, direct-connected, steam-driven, operating at 80 pounds steam pressure, non-condensing, supply electric current at 110 volts for lighting the vessel and for the wireless set, which has a radius of about 600 miles.

230-Foot Steel Cargo Barges

For service on the Mississippi River the firm of Cox & Stevens has also designed a number of steel cargo barges of the following dimensions:

Length on deck	230 feet
Beam, molded	45 feet
Depth, molded	11 feet
Length of cargo box	184 feet
Width of cargo box	37 feet

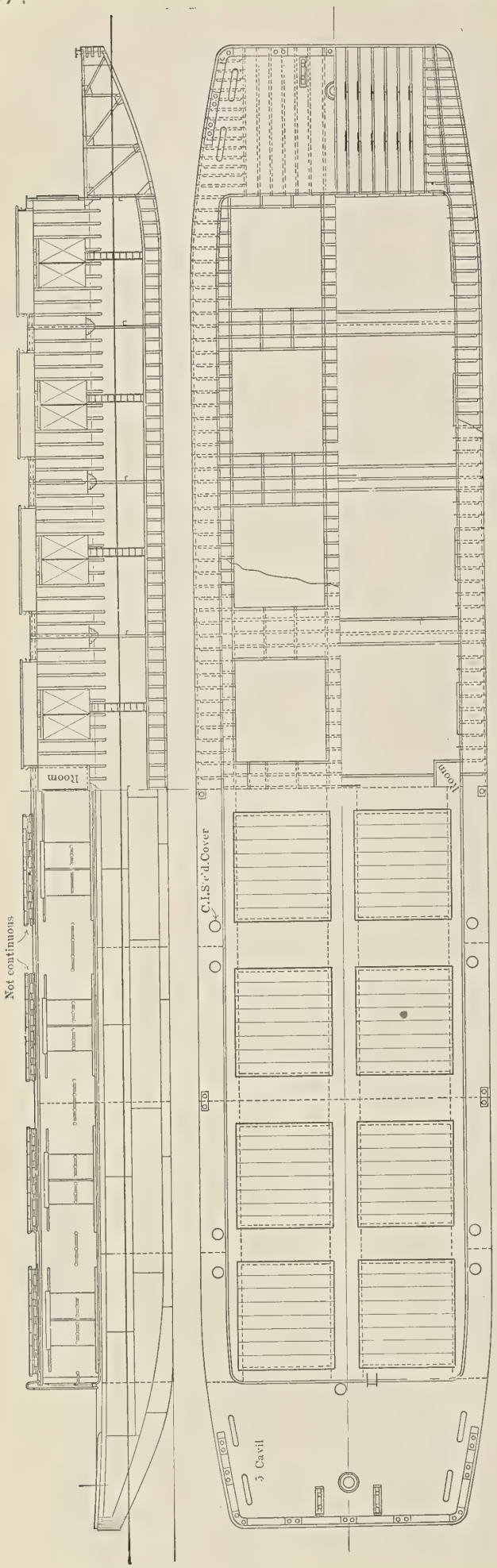


Fig. 5.—Mississippi River Steel Cargo Barge. Length, 230 Feet; Beam, 45 Feet; Depth, 11 Feet; Cargo Capacity on 8-Foot Draft, 2,000 Tons

These barges are designed to carry miscellaneous cargo and bulk oil between St. Louis and New Orleans, or elsewhere, as may be desired, and have a capacity of 2,000 tons of freight on a draft of 8 feet. It is intended that barges of this type will be towed in groups of six by twin-screw tunnel towboats of the type previously described.

The barges are of steel throughout, designed to meet the requirements of the American Bureau of Shipping. The lines show a scow form with long easy raking ends and rounded bilges, designed to reduce resistance in towing upstream in the swift river currents.

The cargo box is provided with sixteen hatches, eight to the side 14 feet by 16 feet, and eight double sliding doors in each side, all arranged for convenience in handling freight. The available cargo space extends from the deck of the cargo box to the floor of the hold, a total depth of 19 feet.

The hold is divided into eighteen compartments by wing and transverse bulkheads, the wing compartments being oil-tight. Pumping arrangements are provided for handling bulk cargo.

140-Foot Tunnel Stern Towboats

A smaller tunnel stern towboat has also been designed by Cox & Stevens for service on the Warrior River. These vessels have the following general dimensions:

Length overall	140 feet
Beam, molded	24 feet
Depth, molded	8 feet 7 inches
Draft, maximum	6 feet

They are of the single-deck type and are fitted with a continuous deck house 112 feet in length running the full length, leaving only room at each end for handling lines, etc.

The forward house contains quarters for engineers, pilots, watchmen and part of the crew, while the after end of the deck house contains the mess room for the white crew, galley stores, quarters and mess room for the colored crew.

The upper house is arranged to accommodate the captain, and the pilot house is fitted with the usual equipment. The pilot house is arranged to give the helmsman a clear view in all directions and is fitted with a powerful searchlight for use in river work at night.

On deck are arranged the necessary number of heavy capstan bitts, cleats and chocks for handling barges in all positions. Especial attention has been paid to the ventilation of the living quarters, so that the crew may at all times be comfortable.

The motive power consists of two triple-expansion engines 10¾ inches, 17 inches and 27 inches diameter by 18 inches stroke, developing 400 horsepower at 200 revolutions per minute. Steam is supplied by two Ward boilers arranged to burn coal as fuel. The machinery plant has been laid out with great care to secure maximum efficiency, and the equipment of auxiliaries is complete in every respect.

The quarters are steam heated, and a generator of 10 kilowatts capacity serves to light the quarters throughout and also supplies current for the searchlight.

For ease in handling, these vessels are equipped with four rudders, two for each shaft, one forward and one aft of the propeller. This arrangement of rudders, in conjunction with tunnel stern construction, has proved particularly satisfactory.

The midship section (Fig. 8) indicates the general type of construction, which is as simple as possible, so as to reduce first cost, particular attention being given to the longitudinal stiffness of the hull, which is arranged by stanchions and diagonal braces in line with the deck

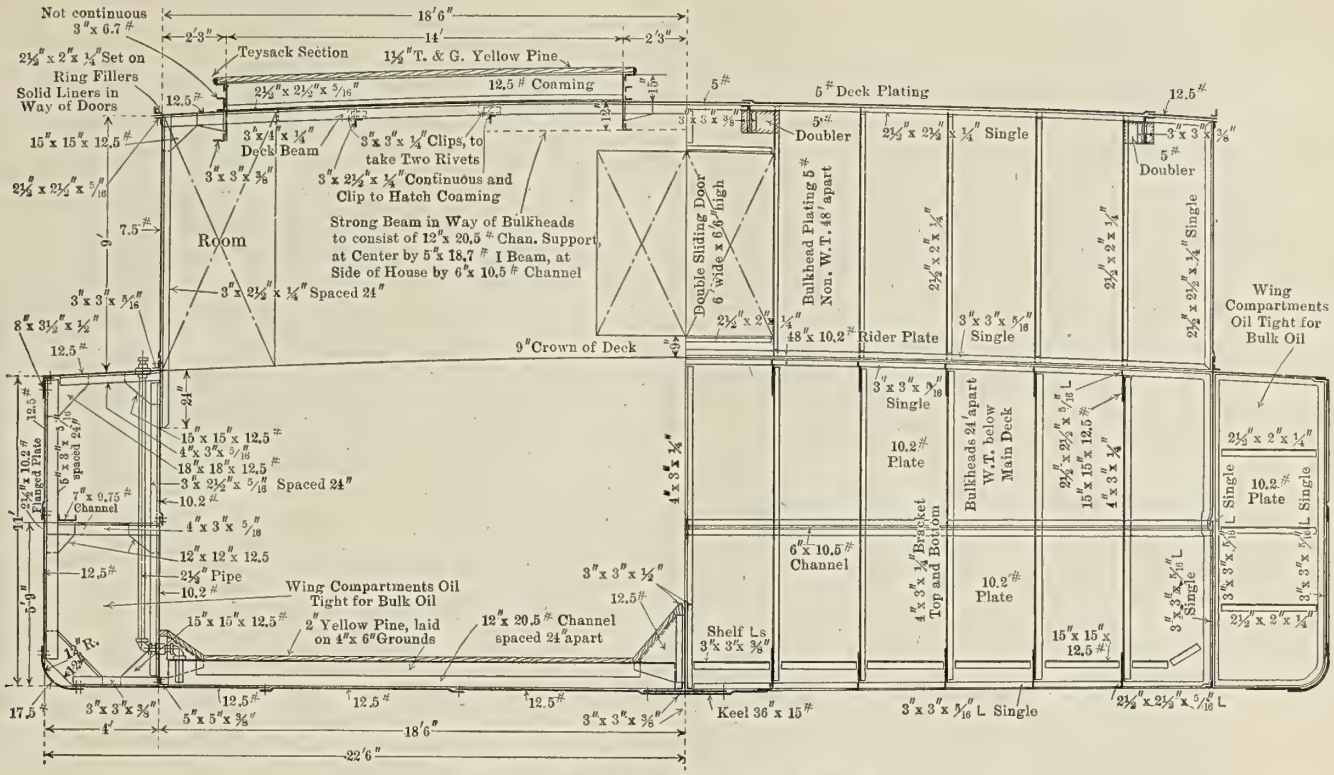


Fig. 6.—Midship Section of 230-Foot Cargo Barge

house side. The construction of the vessel in way of the propeller, showing the details of the tunnel, is especially interesting. Heavy oak fender strips are run along each side, with steel facing plates to protect the hull of the vessel from damage.

280-Foot Twin-Screw Tunnel Stern Self-Propelled Barges

For service on the Tombigbee, Alabama and Black Warrior rivers, Messrs. Cox & Stevens have also designed a self-propelled barge of the following dimensions:

Length overall	280 feet
Beam, molded	49 feet
Depth, molded	10 feet
Draft, maximum	7 feet

The hull shows the usual barge section, with bows shaped slightly for easy entrance and with two tunnels aft. Cargo is carried on the main deck. An open cargo box somewhat forward of midships provides for 1,600 tons of coal. At each end of the coal box are enclosures for package freight, the forward enclosure being 24 feet long, provided with two hatches 12 feet by 16 feet in the top and a sliding door in each side. The after enclosure is

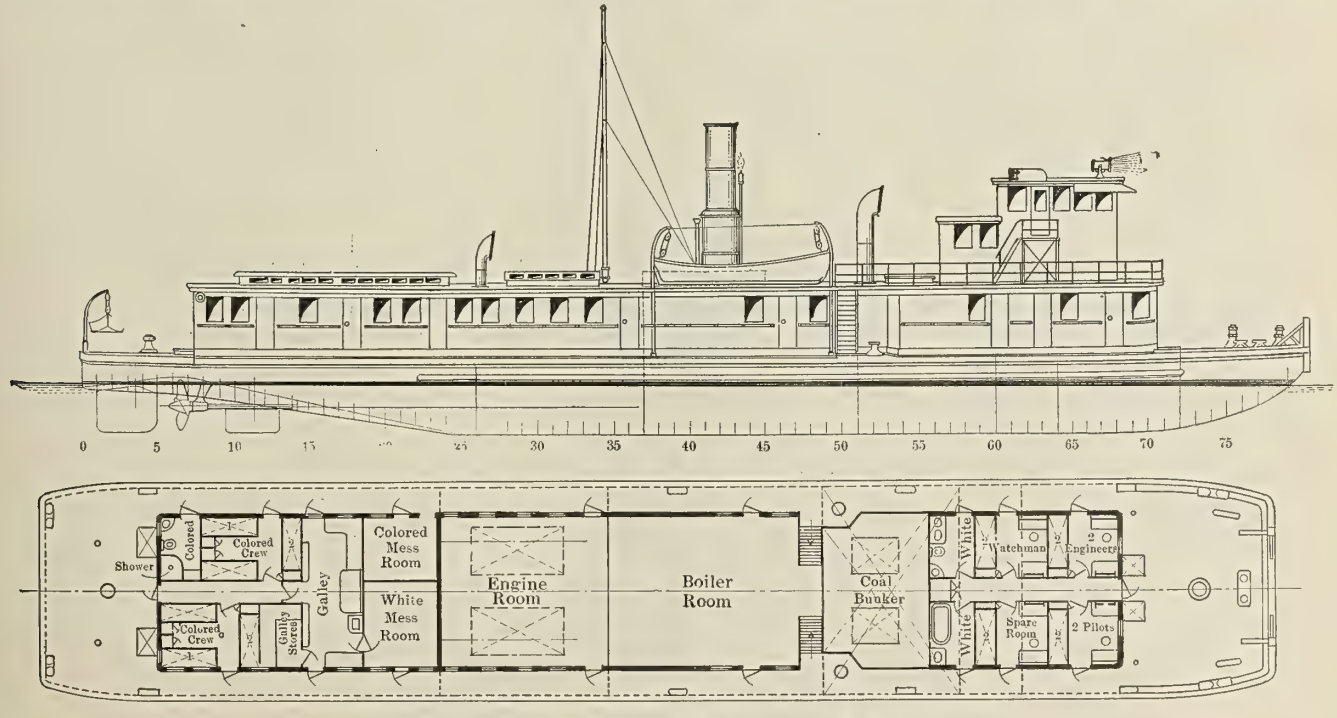


Fig. 7.—140-Foot Tunnel Stern Towboat for Warrior River

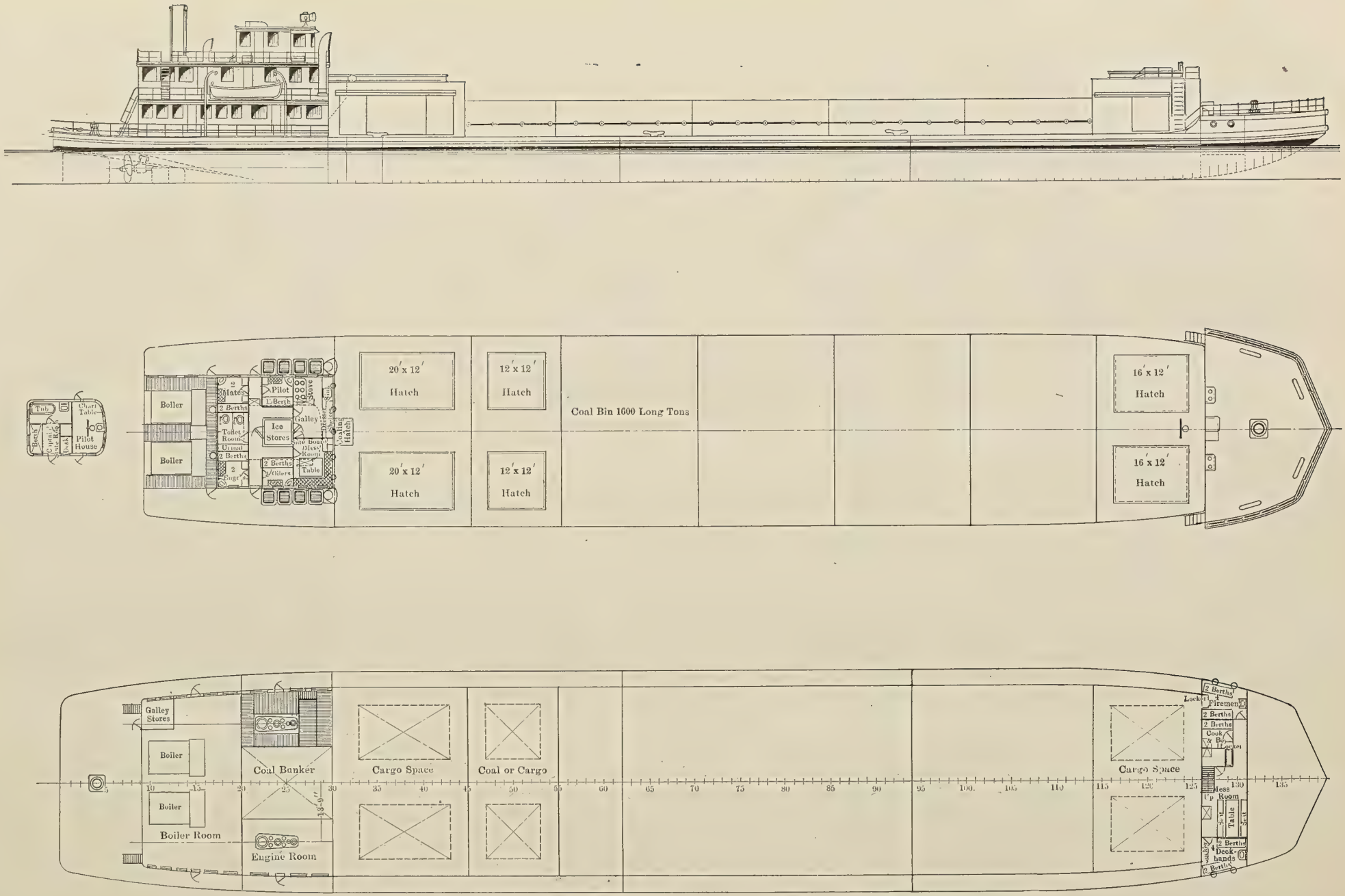


Fig. 8.—Twin-Screw, Tunnel Stern Self-Propelled Barge. Length, 280 Feet; Beam, 49 Feet; Depth, 10 Feet; Indicated Horsepower, 800

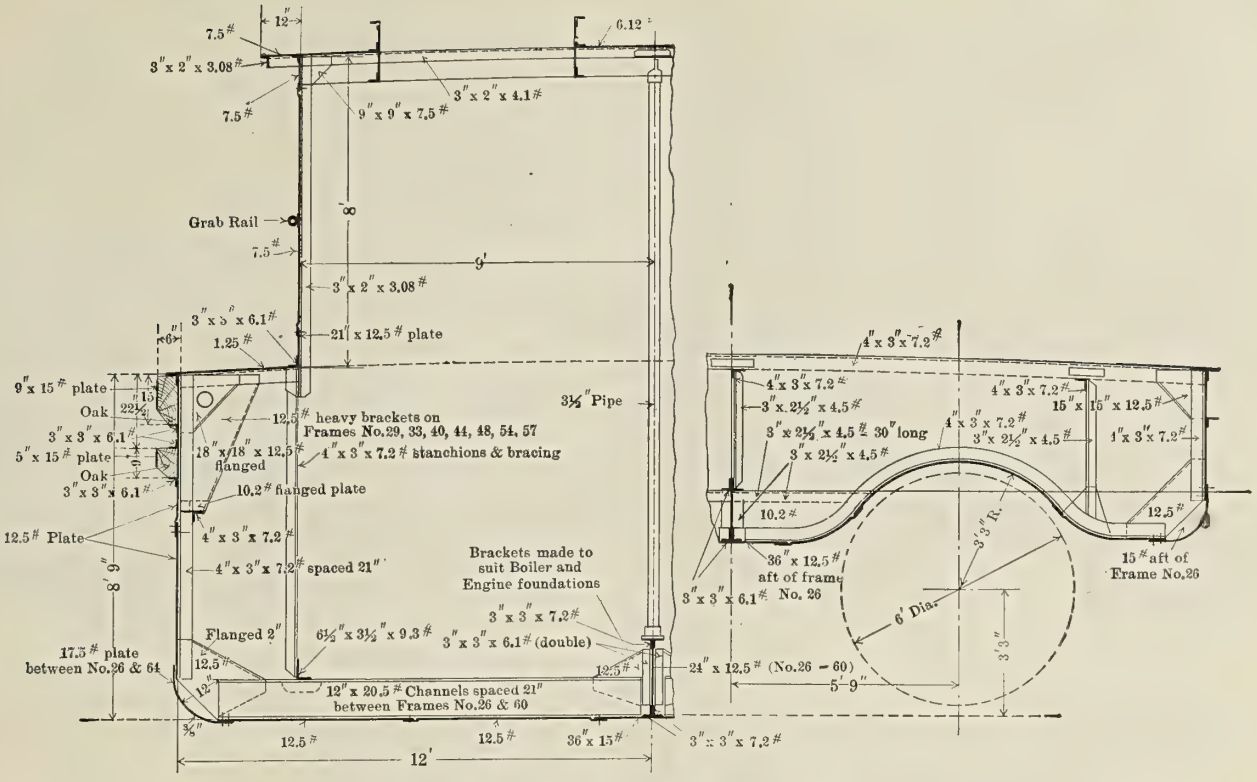


Fig. 9.—Midship Section of 140-Foot Tunnel Stern Towboat

50 feet long with four hatches, two 12 feet by 12 feet and two 12 feet by 20 feet, and has two doors to each side.

The crew's quarters are forward below deck, with accommodations for four deck hands, four firemen, cook and messman. The engine enclosure and principal quarters are in the after house, as shown in the plan (Fig. 8). The pilot house, with quarters for the captain, is located on top of the upper house.

In the tunnels are four balanced rudders, two on each side, one forward and one aft of each propeller. This

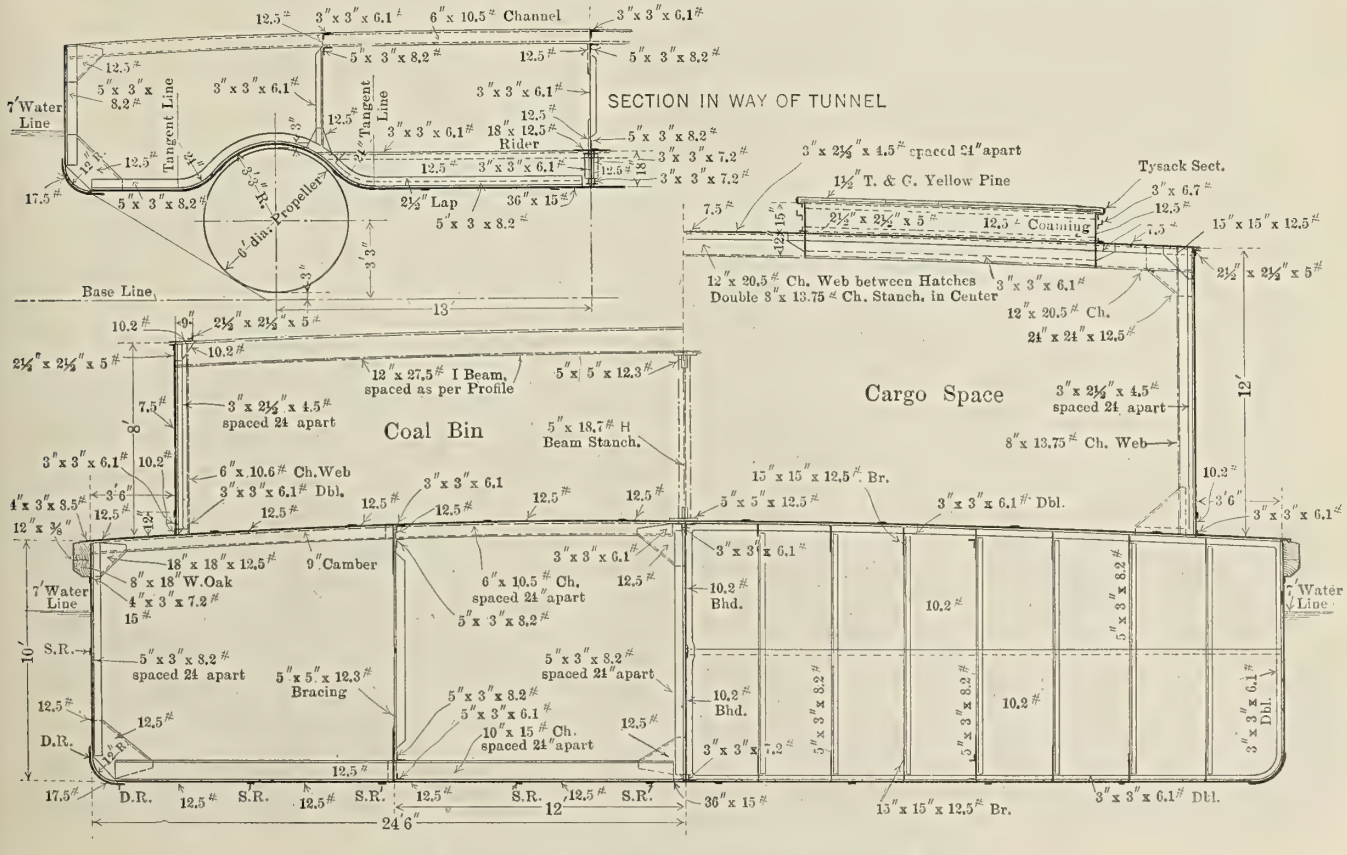


Fig. 10.—Midship Section of 280-Foot Self-Propelled Barge

arrangement is calculated to give the best results when going either ahead or astern. The propellers turn outboard right and left and will give a maximum speed of 8 miles per hour loaded.

The propelling engines consist of two inverted-cylinder triple-expansion engines with cylinders 10¾ inches by 17 inches by 27 inches diameter and 18 inches stroke, designed to operate at a working pressure of 225 pounds and to develop 400 indicated horsepower at 200 revolutions per minute. The engines are provided with one surface condenser of 1,100 square feet cooling surface, an independent air pump and a centrifugal circulating pump.

The boilers are of marine watertube type, two in number, each to have approximately 1,400 square feet heating surface and 39 square feet grate surface, arranged for bituminous coal, hand-fired, natural draft.

The generating set is of 7½ kilowatts 110 volts, direct-connected to vertical steam engine, to operate at 80 pounds steam pressure.

These vessels, as well as the others, were designed in accordance with the requirements of the American Bureau of Shipping. Taken altogether, these boats represent a distinct advance in the design of floating equipment for river and canal service, and their performance in service will be watched with interest.

Production Speed—Oxy-Acetylene Cutting One Answer*

BY R. R. BROWNING†

WITH the inauguration of submarine warfare by Germany, it became immediately apparent to the American shipbuilding industry that steel ships, without number, would be required. The oxy-acetylene cutting process, which, since its introduction into this country, has been used by the steel shipbuilder, was one of the first processes to be called upon to speed up production in old as well as in new shipyards. The development of the application in the shipyards occasioned by the demand for more ships was a matter given special attention by the welding committee of the United States Emergency Fleet Corporation, by the American Bureau of Shipping, and by Lloyds. The result was the application of the process to such important work as the following:

Cutting or trimming of plates and structural iron to shape;
Making manholes, portholes, patches, ventilator and funnel openings, stairway openings, mast openings and headlights;
Trimming stem and stern posts;
Cutting frames and plates;
Cutting shafting, pipes, chains, rivets and scrap.

The majority of these applications were made absolutely essential during the war in the speed-up schedule required through the time limit placed on production, a most interesting example being that of cutting portholes.

It has always been customary in shipyards to punch a large number of holes with a ½- or ¾-inch punch around the periphery of the proposed porthole. The central portion, or plate, was in this manner removed and the edges then trimmed by means of a chipping hammer. An average of one and a half hours was required to make in this manner a 12-inch diameter porthole, whereas with an oxy-acetylene circular cutting blowpipe and a simple attachment the portholes were during the war and are now completed in an average time of five minutes each. This not only shows a considerable saving in time and cost in doing the work, but it can also be said that the finished porthole, as made by the oxy-acetylene cutting process, is better in appearance than that of the older process.

* From a paper read before the annual convention of the International Acetylene Association, New York, July 15-17, 1919.
† Vice-president, Oxweld Acetylene Company, Chicago, Ill.

New Repair Facilities of the Todd Shipyards Corporation

THE shipbuilding and repair facilities of the Todd Shipyards Corporation are well illustrated in the accompanying views of the company's yards on the Atlantic and Pacific. These facilities have recently been effectively increased by the placing in commission of the third section of the 8,800-ton floating dry dock at the plant of the Clinton Dry Docks, Inc., Clinton street, Brooklyn. When the fourth and last section is placed in operation, probably during October, the dock will have an overall length of 428 feet, with a width of 114 feet. The dock can handle vessels up to 500 feet long.

Construction of two piers, one 800 feet long and 125 feet wide, and the other 600 feet long and 150 feet wide,

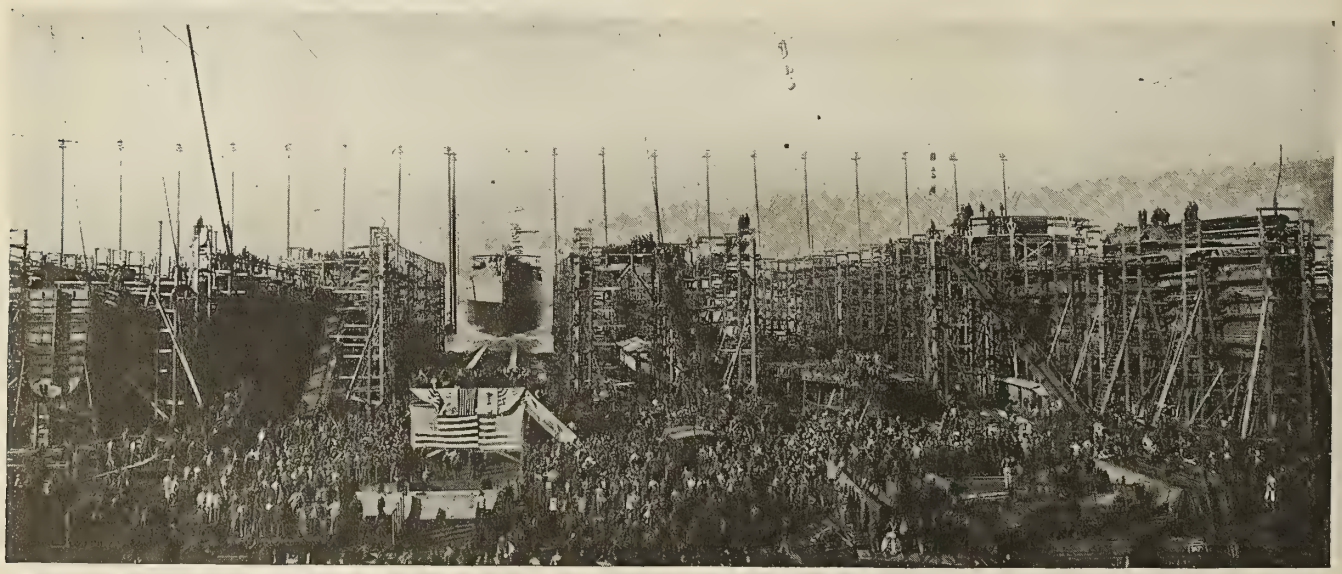


Fig. 1.—Plant of Todd Dry Dock & Construction Corporation, Tacoma, Wash.



Fig. 2.—Plant of Tietjen & Lang Dry Dock Company, Hoboken, N. J.

is also nearing completion. In the construction of the dry dock it was necessary to dredge to a depth of 37 feet below water level, so that the dock might function effectively. For this reason the pier to which it is moored is especially strong. The construction of the dock, which is equipped with Alberger pumps and driven by General Electric motors, has been carried out by Harry Cossey, Tottenville, S. I.



Fig. 3.—Plant of Robins Dry Dock & Repair Company, Erie Basin, Brooklyn

Ballin Composite Ships of 4,400 Tons D. W.

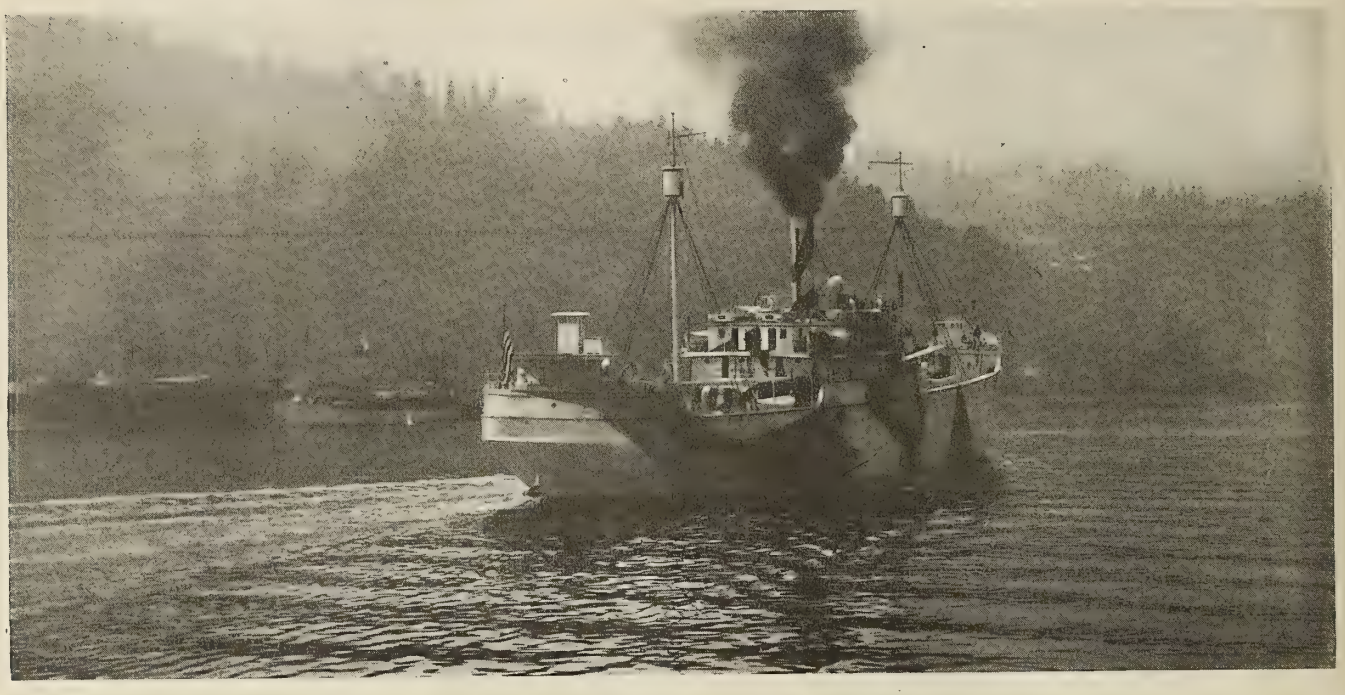


Fig. 1.—One of the Ballin Composite Steamships Leaving for Trial Trip

AMONG the wooden steamships built for the Emergency Fleet Corporation during the war period, eleven of the Ballin composite type were built by the Supple-Ballin Shipbuilding Corporation, Portland, Ore. The outstanding feature of these vessels, in so far as the hulls are concerned, is a steel topside construction in combination with double diagonal planking under a fore and aft course of heavier outside planking, and triple-floored frames, with light topside timbers. The machinery for these vessels, while not only much larger but also of quite a different design from that installed in the standard wooden ship, was built and installed by the Pacific Marine Iron Works, of Portland, Ore.

The hulls are of the following dimensions:

Length overall	307 feet 0 inches
Length between perpendiculars	295 feet 5 inches
Beam, molded at deck	43 feet 0 inches
Breadth, extreme over planking	44 feet 7½ inches
Depth, molded	26 feet 0 inches
Draft, full load	23 feet 2 inches
Speed on trial, mean	12.48 knots
Cubic capacity, bale, about	150,000 cubic feet
Cubic capacity, grain, about	165,000 cubic feet
Deadweight tonnage at load draft	4,400 tons
Coal bunker capacity, permanent, about	150 tons
Coal bunker reserve, coal or cargo	300 tons
Fresh boiler feed water tanks, about	74 tons
Fresh culinary water tanks, about	25 tons
Gross tonnage	2,799 tons
Net tonnage	1,676 tons

The vessels are of the three island type, with machinery amidship, and are rigged with two masts with four cargo booms on each mast, each of three tons capacity. There are four large cargo hatches.

The machinery space is divided from the cargo holds by watertight bulkheads. The permanent coal bunkers are located abreast of the fireroom, extending from bilge to main deck. The bridge enclosure may be used for either coal or cargo.

The reserve feed is carried in two steel tanks located at the after end of the engine room, and the culinary water in two tanks fixed at the starboard side of the engine room.

Hull Construction

The outstanding feature of the hulls, as previously mentioned, is the steel topside construction in combination with double diagonal planking, under a fore and aft course of heavier outside planking, and triple-floored frames, with light double top timbers.

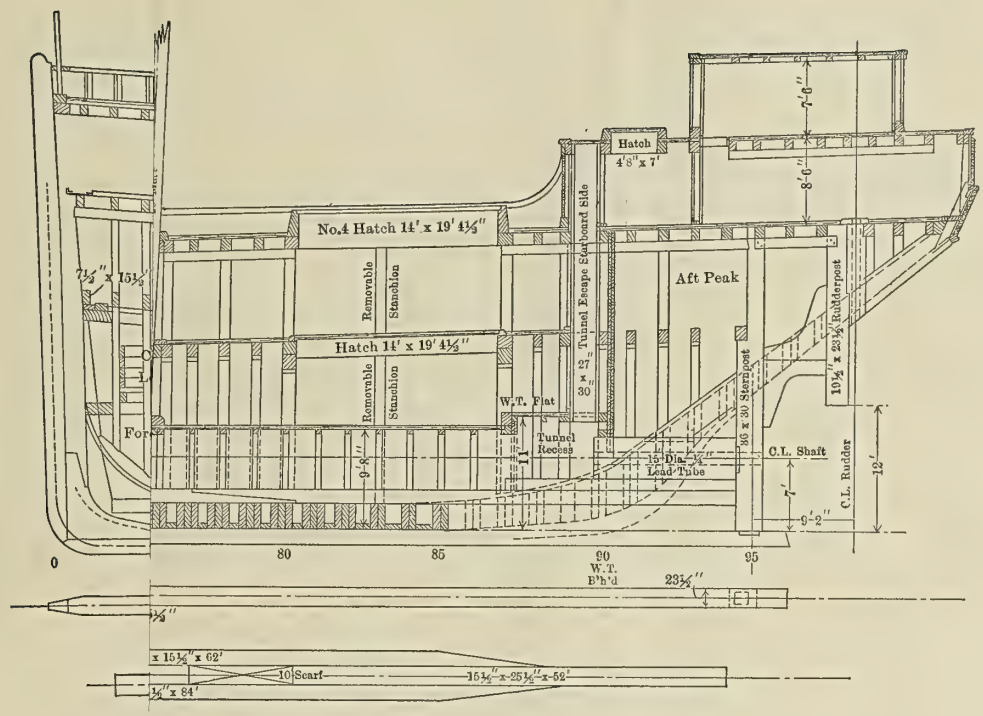
The floors are molded 30 inches at the keel, 18 inches at the bilge and are triple-sided 7½ inches. The top timbers are molded from 18 inches at the bilge to 12 inches at the main deck and are double-sided 7½ inches. The spacing is 36 inches. This construction affords a maximum of bottom strength with the minimum of weight in the top timbers, the whole being a construction which is justified by rational engineering principles when used in conjunction with the double diagonal sheathing and steel topsides.

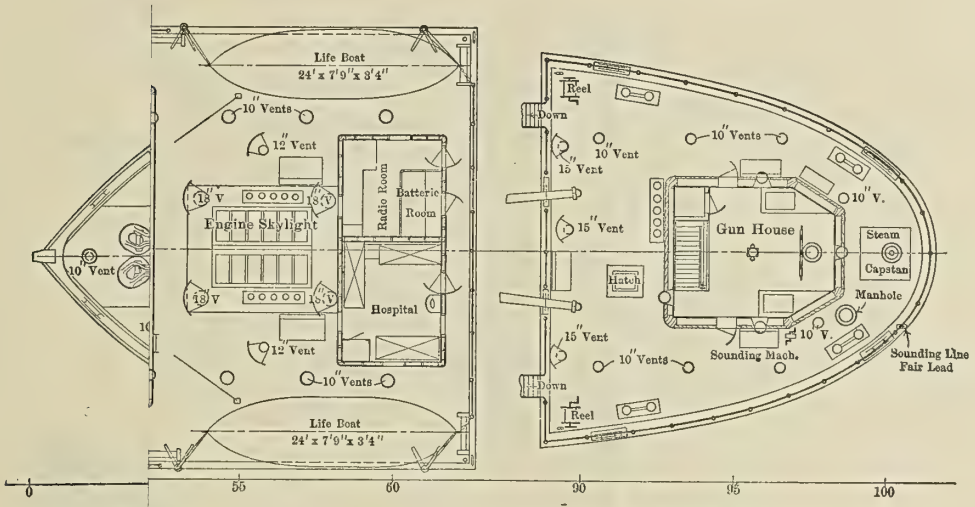
The ceiling is about one-half the thickness customarily used in wooden vessels of this size, thereby resulting in a great reduction of weight and some additional cubic capacity.

The steel topsides construction consists essentially in a wide outer or sheer strake, an inner or bulwark plate, a stringer plate and a rail plate, except in way of the bridge erection, where double angles are substituted for the rail plate to preserve the continuity of strength. The various strakes are assembled on a staging, completely riveted, and then launched into place. They are fastened to the woodwork and diagonal sheathing with countersunk head screw bolts of ample size and number. The bolts, falling in way of the steel knees, pass through the flanges of same. Those bolts through the stringer have special heads designed to prevent all likelihood of leaks.

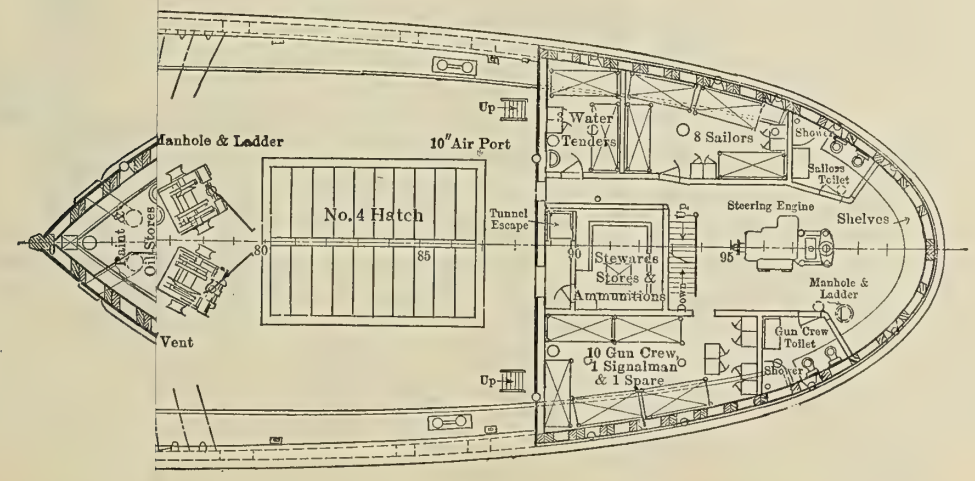
Extending diagonally athwartships from stringer to stringer are four sets of diagonal straps, let in flush with the top of the beams. Additional straps are disposed

EIGHT



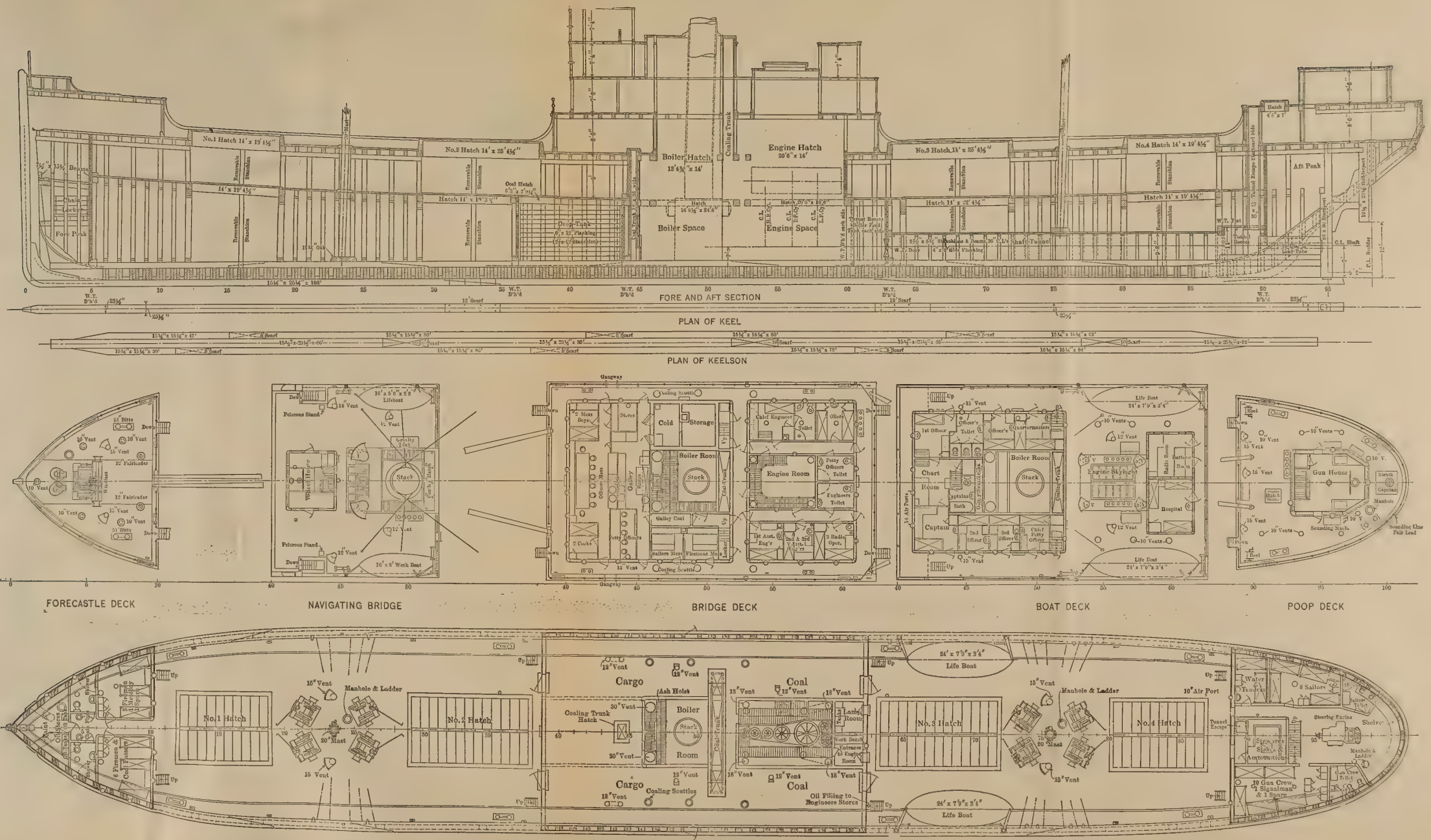


FOR DECK POOP DECK



BALLIN COMPOSITE SHIP OF 4,400 TONS DEADWEIGHT

Built by the Supple-Ballin Shipbuilding Corporation, Portland, Ore., and Engined by the Pacific Marine Iron Works, Portland, Ore.



Figs. 2 and 3.—Inboard Profile and Deck Plans

BALLIN COMGHT

Built by the Supple

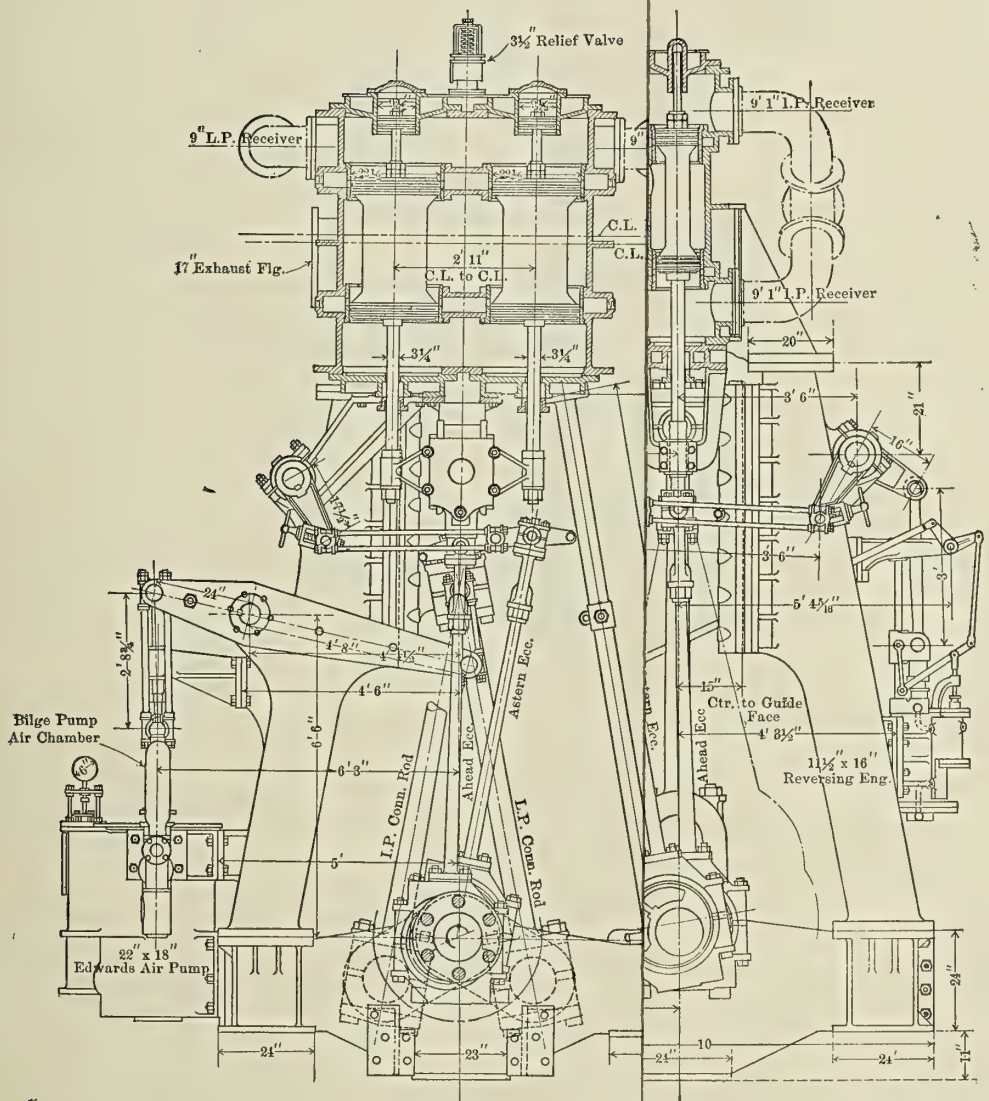


Fig. 4.—Main Engine: Diam

BALLIN COMPOSITE SHIPS OF 4,400 TONS DEADWEIGHT

Built by the Supple-Ballin Shipbuilding Corporation, Portland, Ore., and Engined by the Pacific Marine Iron Works, Portland, Ore.

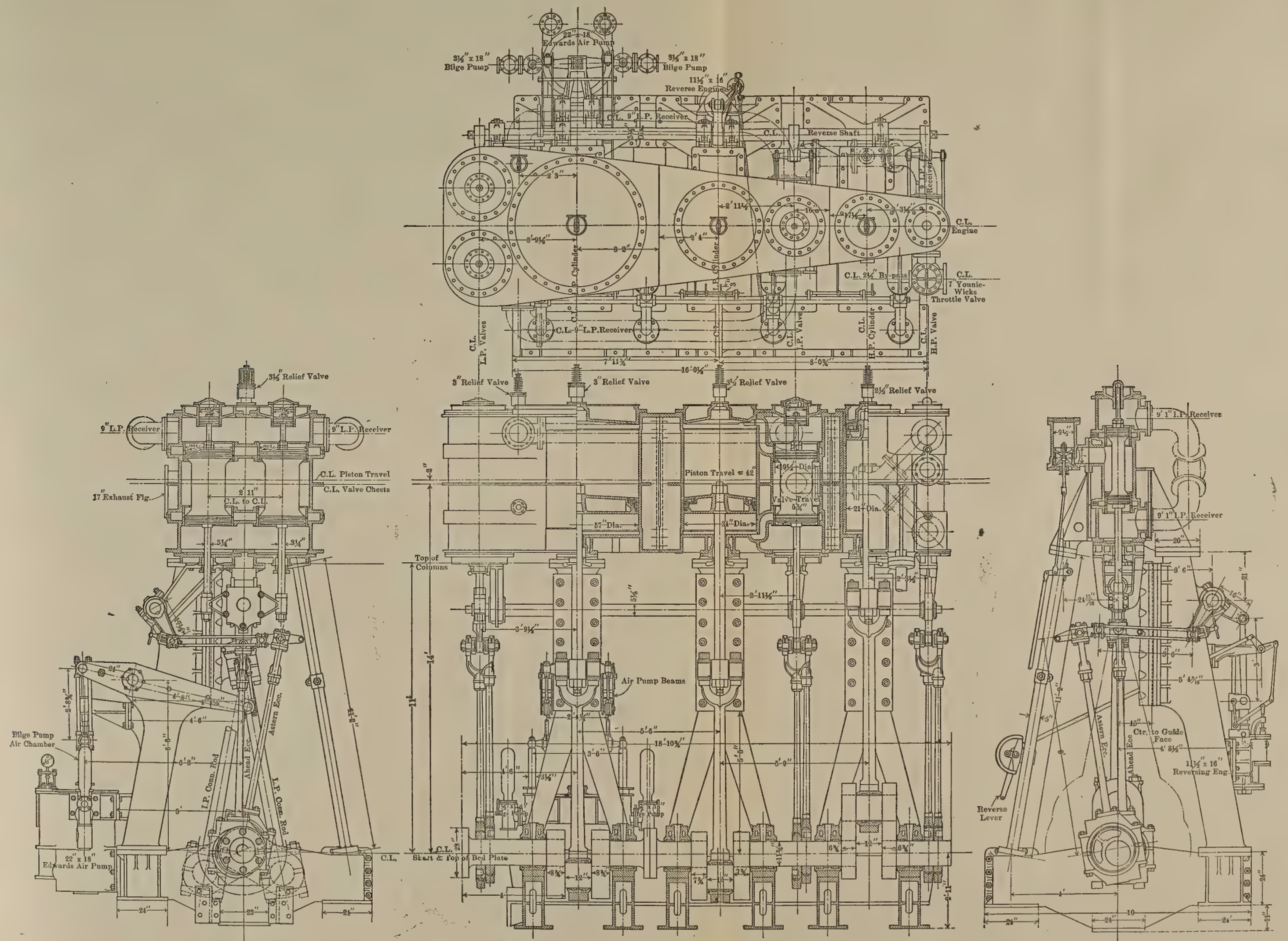


Fig. 4.—Main Engine: Diameters, 21, 34 and 57 Inches; Stroke, 42 Inches; Weight, Approximately, 190,000 Pounds; Revolutions Per Minute, 86; Indicated Horsepower, 1,800

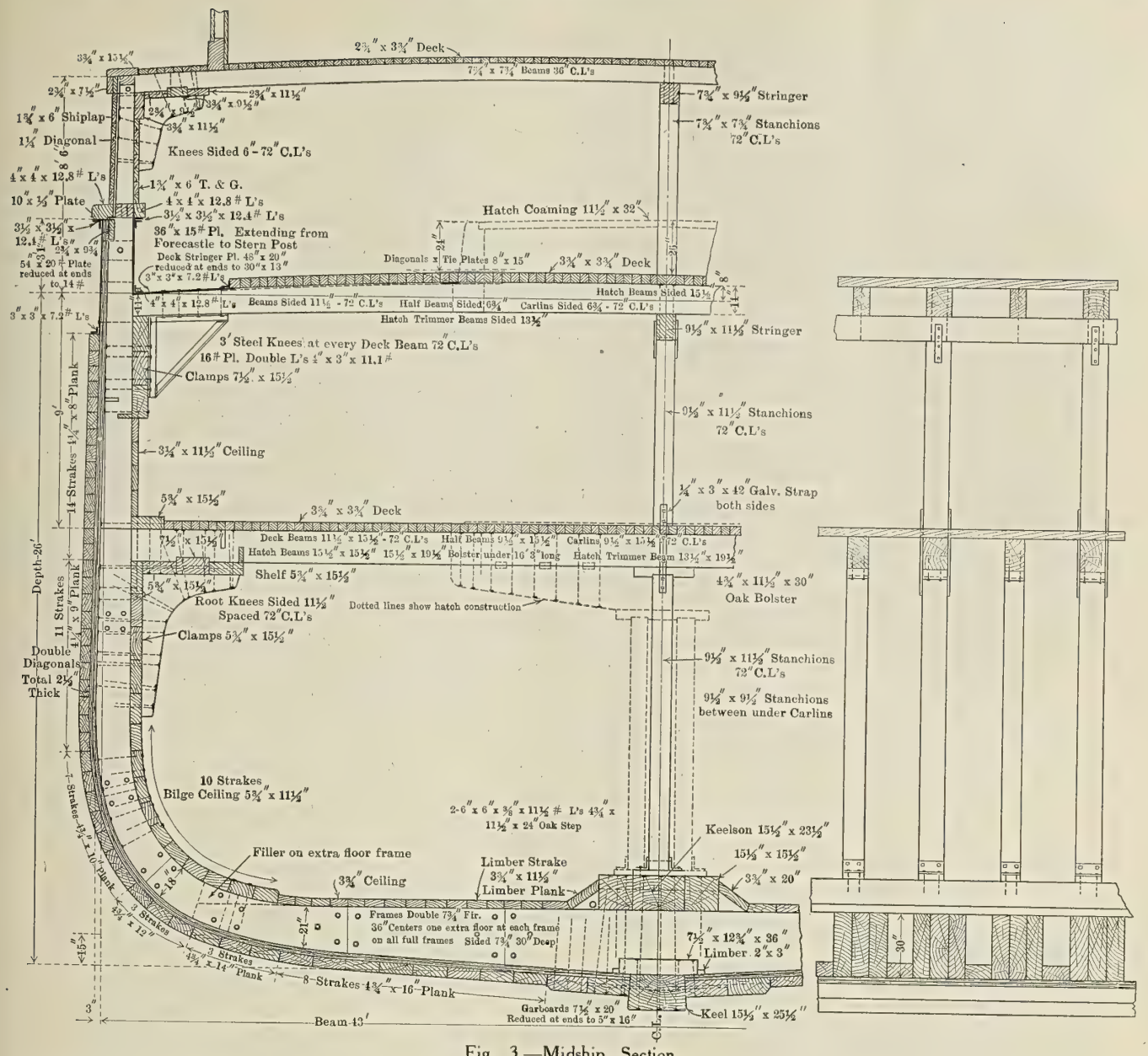


Fig. 3.—Midship Section

longitudinally on each side of the hatchways and extend fore and aft to the stringers. The whole of the facing surfaces of the steel work is thoroughly painted with hot bitumastic composition before launching into place, thus affording complete protection against corrosion. Riveting is in accordance with American Bureau of Shipping requirements.

The whole of the woodwork of the hull receives a thorough coating of creosote, or carbolineum, before erection. The double diagonal is dipped in hot carbolineum. Surfaces exposed during construction are recoated with this preservative. No salt is used.

Propelling Machinery and Auxiliaries

The ship is propelled by a single vertical inverted triple-expansion engine with cylinders 21 inches, 34 inches and 57 inches in diameter with a common stroke of 42 inches, designed for an indicated horsepower of 1,800 at 86 revolutions per minute, and weighs approximately 190,000 pounds complete.

The high-pressure and intermediate-pressure cylinders are each fitted with a single piston valve 10¼ inches in diameter for the high pressure and 19¼ inches in diameter for the intermediate pressure. The low-pressure cylinder is fitted with two piston valves each 22¼ inches in diameter. The intermediate-pressure and low-pressure valves are balanced with balance pistons.

The travel of the valves is 5¾ inches and is the same for all valves.

The valve gear is of the Stephenson double bar link type controlled by a reverse shaft, bracketed on the back columns, and operated by a direct-acting floating valve control, reverse cylinder 11½ inches in diameter and 16 inches stroke. No springs or bumpers are supplied, the cushioning of the reverse piston being effected by special arrangement of the steam ports in the cylinder.

The crank shaft, built up in two sections with a coupling between the intermediate-pressure and low-pressure cranks, is 11¾ inches in diameter in the crank pins and journals. The crank arms are forged steel, shrunk onto the pins and journal sections and keyed. The coupling bolts are 2¾ inches in diameter and parallel.

A 6-inch by 6-inch single-cylinder reversible turning engine is provided and mounted on the starboard thrust block strut.

A direct-connected air pump of the Edwards type, 22 inches in diameter, 18 inches stroke, is mounted on the low-pressure back column and driven off the low-pressure

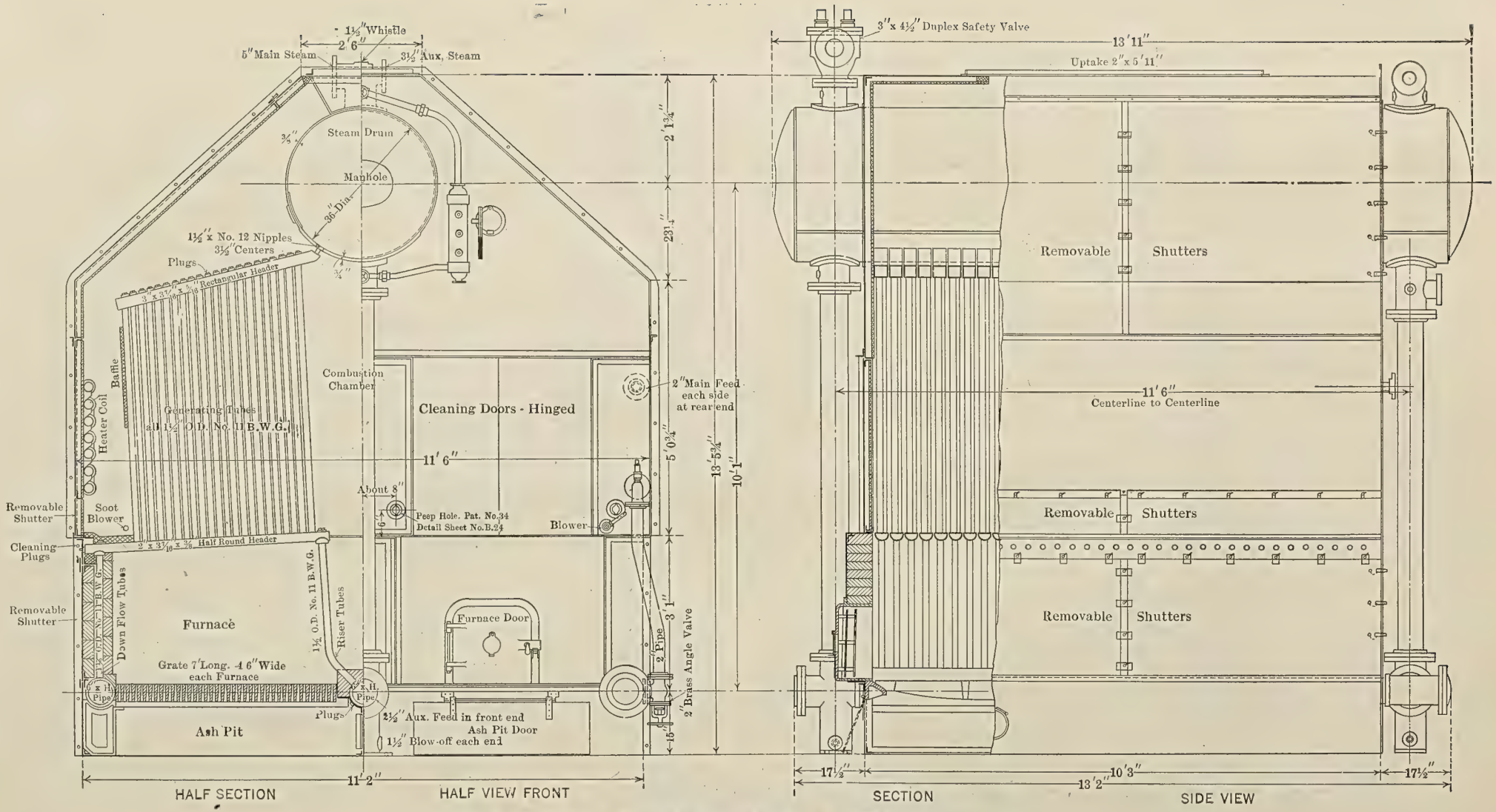


Fig. 6.—Ballin Type Watertube Boiler Installed on 4,400-Ton Composite Ship



Fig. 7.—Stern Framing

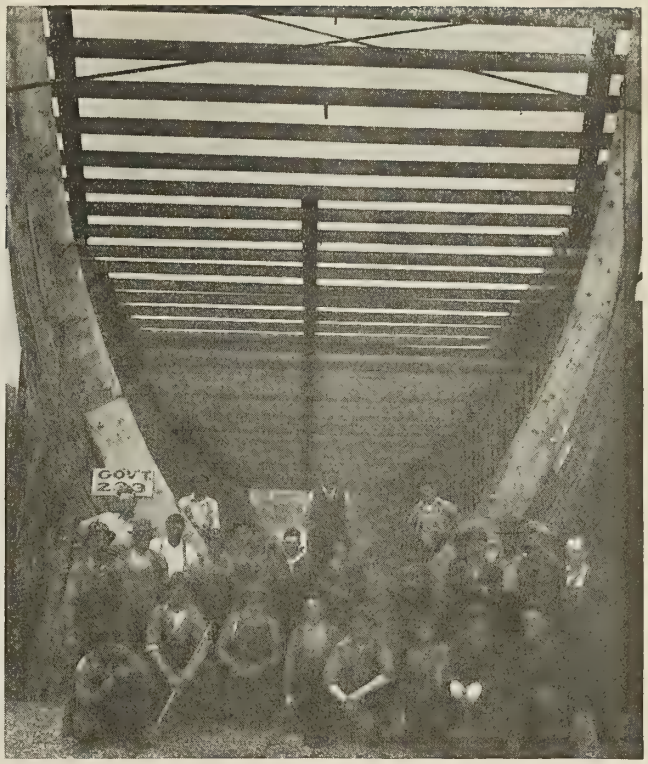


Fig. 8.—Main Framing

crosshead. Two direct-connected bilge pumps are attached to the body of the air pump and driven off the air pump crosshead. They are 3½ inches in diameter.

The thrust bearing is of the horseshoe type with six collars 21 inches in diameter, 2 inches thick. The horseshoes are of cast iron cast hollow for water circulation. The thrust shaft is 11¾ inches in diameter. The intermediate shaft is 11¼ inches in diameter and 80 feet long in four sections of 20 feet each, each section being supported by a single bearing 12 inches long. The propeller shaft is 12½ inches in diameter, 25 feet 8¼ inches long.

The propeller is a right-hand true screw, with four semi-steel blades mounted on a semi-steel hub. The diameter is 14 feet 6 inches, with a pitch of 14 feet. The developed area is 63.4 square feet, the projected area 54.7 square feet, and the ratio of developed area to disk area 1 to .384. Immersion of the upper tip at load draft is about 8 feet 2 inches.

An independent surface condenser is provided, containing 2,500 square feet of cooling surface. The circulating pump is of the centrifugal type with a 10-inch suction and discharge driven by a 9-inch by 9-inch single-cylinder inverted vertical steam engine.

Boilers

Steam at 200 pounds gage pressure is furnished by two Ballin watertube boilers, arranged for coal firing. Each boiler has a heating surface of 3,500 square feet and a grate surface of 51.17 square feet. Each boiler contains 1,496 tubes having an external diameter of 1½ inches. The area of the smokestack is 23 square feet, and the height above the grate 70 feet. The ability of these boilers to furnish dry steam in ample quantities for the main engine and auxiliaries with natural draft is fully demonstrated by the trial data. No forced draft is installed.

Deck Machinery

Cargo is handled by eight 8-inch by 8-inch single-drum spur-geared winches, with direct steam valve control. The windlass is of the spur-geared type with double wildcats and extra large gypsy heads on each side and with engines 8 inches by 10 inches.

The steering engine is of the steam screw type attached to a yoke on the rudder stock, with telemotor control and

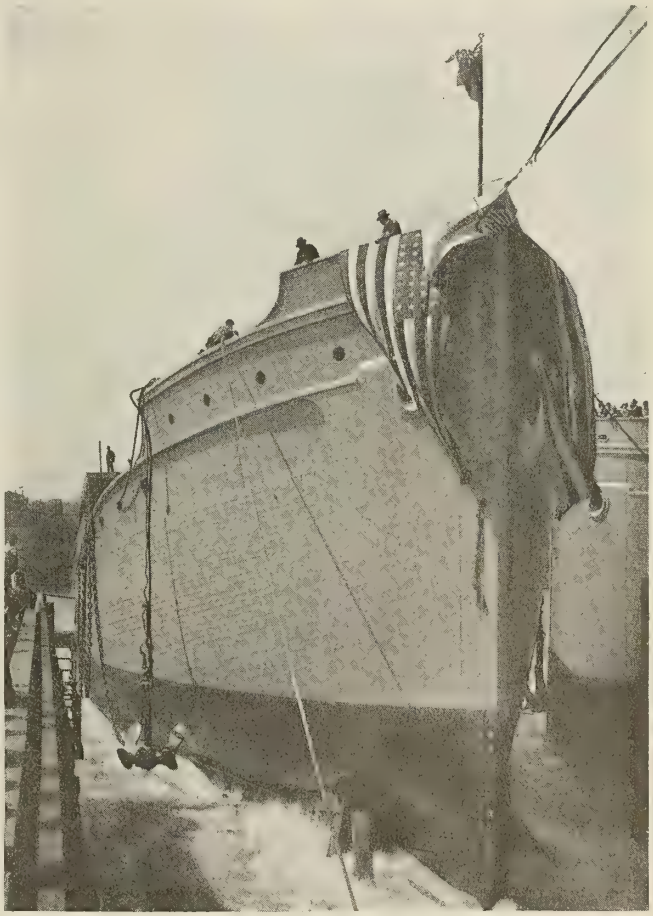


Fig. 9.—Launching of Composite Ship



Fig. 10.—Composite Vessel at Fitting-Out Berth

engine 5 inches by 6 inches. A steam warping capstan is located on the poop deck aft.

Auxiliaries

The following pumps and auxiliaries are furnished:

Fire and bilge pump, horizontal duplex, 10 inches by 6 inches by 10 inches.

General service pump, horizontal duplex, 10 inches by 6 inches by 10 inches.

Sanitary pump, horizontal duplex, 6 inches by 6 inches by 6 inches.

Evaporator feed pump, horizontal duplex, 4¾ inches by 2¾ inches by 4½ inches.

Fresh water pump, horizontal duplex, 4¾ inches by 2¾ inches by 4½ inches.

Main feed pump, vertical simplex, 10 inches by 6 inches by 12 inches.

Auxiliary feed pump, vertical simplex, 10 inches by 6 inches by 12 inches.

Ice machine, 1-ton direct ammonia expansion.

Engine generator set, 10 kilowatts; direct-connected engine, 5 inches by 5 inches, 600 revolutions per minute.

Feed water heater, horizontal closed; capacity, 30,000 pounds per hour; 210 to 212 degrees with steam at 5 pounds back pressure.

Evaporator, enclosed coil, 15-ton capacity in 24 hours.

The trial trip data furnished herewith are the minimum and maximum readings taken during a trial run over a measured nautical mile and over a measured course of 12 nautical miles, while the deduced data are the average for the above trial trip, together with a 24-hour endurance run at sea:

Full Power Trial Data

1-Mile and 12-Mile Runs

Mean speed	12.48 knots	
Mean indicated horsepower, main engines	1,742	
Mean indicated horsepower, auxiliaries	100	
Mean revolutions per minute, main engines	83	
	Maximum	Minimum
Steam pressure, boilers, pounds	195	185
Steam pressure, high-pressure receiver	145	143
Steam pressure, intermediate-pressure receiver	74	70
Steam pressure, low-pressure receiver	18	18
Quality of steam, calorimeter, percent	98	97.9
Stack temperature, degrees Fahrenheit	600	500
Flue gas analysis, percent—		
CO_2	11.1	9.9
O	9.6	8.4
CO	0.0	0.0
Pounds water per hour, including auxiliaries		27,500
Pounds coal per hour, including auxiliaries		3,090
Pounds water per pound of coal		8.9
Feed temperature, degrees Fahrenheit		200
British thermal units per pound of fuel as fired		12,451
Evaporation from and at 212 degrees Fahrenheit, pounds		9.41
Efficiency of boiler, based on fuel as fired, percent		72.2

Eight of these ships have been outfitted, trials run and made ready for service up to this time, and at the present time there are three more under process of outfitting and will be ready for service in a short time.

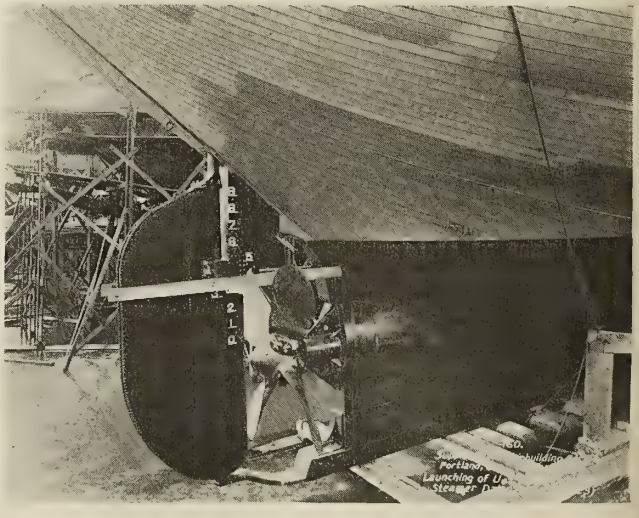


Fig. 11.—Stern of Composite Ship

Training of Enlisted Personnel of the United States Navy for Engineering Duties

BY LIEUTENANT COMMANDER R. R. SMITH, U. S. N.

(Published with permission of United States Navy Department)

AT the outbreak of the war the Bureau of Navigation of the Navy Department was confronted with the problem of supplying trained engineer personnel to man not only the vessels of the Navy in reserve, which were then being rushed into active commission, but the interned German and Austrian ships which were completing the repairs necessitated by the sabotage they suffered during their internment. New construction in excess of anything heretofore attempted was being planned, while construction under way was being rushed to completion. Deck personnel was required also, but, as Navy training has always chiefly concerned itself with the training of its deck personnel, facilities and methods were already available for this training and only required expansion. The training of the engineering personnel has, however, always been a slower process on account of the greater degree of skill required in the handling of mechanisms. Our merchant marine was small and the comparatively few merchant engineers could not be spared to the Navy. Naval recruits by the thousands could be sent to these ships, but the sending of green men to do the work of trained engineers and firemen was rejected as impracticable.

A conference was called at the Bureau of Navigation, which was attended by representatives of the commander-in-chief of the Atlantic fleet. The representatives from the fleet proposed a scheme which meant a new departure for the Navy. It required setting aside a great many old ideas, but it sounded good. The conference adjourned until the next day, when the details which had been worked out over night were presented. They were accepted, and at the suggestion of the chief of bureau it was decided that an officer should be ordered to the staff of the commander-in-chief to follow up the development of the scheme proposed.

The Proposed Scheme

The salient features of the proposed scheme as outlined in the commander-in-chief's letter were as follows:

(1) Eight battleships of the older type to be assigned to the paramount duty of training engineers.

(2) Reduction of deck complement to one-half to make room for the increased number of engineers.

(3) Greatly increasing the engineer petty officers to provide suitable instructors.

(4) Removal of practically all firemen from ships assigned to this duty.

(5) Increasing the number of trained engineer officers for each engineering ship.

The only two ships available at the time were the *Alabama* and the *Kearsarge*. Later six more ships joined the training squadron. These ships were ordered to revise their complements immediately and to transfer all engineer personnel except ninety men. Additional petty officers to make up the ninety in the required ratings were transferred from battleships not engaged in this work. All battleships were to regard one-third of their engineer complement as available for transfer, being obliged to train recruits to this number for their own vacancies.

A senior assistant to the engineer officer and two commissioned officers of engineering experience for training officers were ordered to each training ship. The complement of petty officers was as follows:

Chief machinist mates	9
Chief water tenders	9
Machinist mates, first class	9
Water tenders	27
Oilers	18
Firemen, first class	18
Total	90

The firemen were for the ship's use on evaporators, ice machines, steamers and other auxiliaries where some permanence was essential. Each ship was required to train the following men at one time:

Engine drivers	16
Oilers	32
Water tenders	32
Firemen	200
Total	280

There was thus a total of 370 engineers on board, not including the electrical force, which brought the total to nearly 400. The regular engineer complement of the *Alabama* for war conditions was 170, and during peace much less than this. In order to facilitate the work of receiving, stationing and transferring so large a number of men, it was decided that half be transferred at a time. Six weeks was decided upon as the training period. In order to alternate the transfer and commence the system, half of the men had to be transferred at the end of the first three weeks. The better half were selected, this being possible owing to the fact that the first men received came from the other ships, had been on board anywhere from one to three months and had got some training before being received on board.

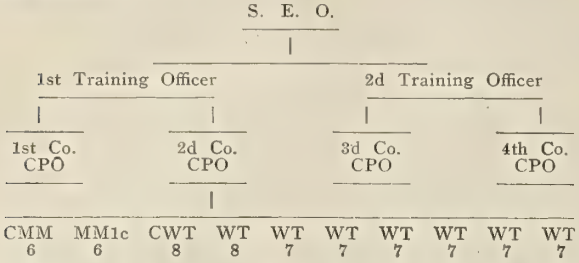
Upon the internal organization of the ship depended the success of the entire scheme. It was realized that the moment the individual man under training did not receive close personal supervision by some one person, the entire scheme would fall down. The entire organization was based on this idea and the squad system was inaugurated.

It has been stated that no one person can intelligently supervise the entire work of more than eight men; when the number is increased beyond this the closeness of the supervision is relaxed.

Squad System Inaugurated

The men under training were divided into four companies. Each officer had two companies, each company was commanded by a chief petty officer. The company consisted of seventy men under training, divided into ten squads, each squad being commanded by a petty officer not below the rating of first class. Two of these squads were engine room squads, of six men each, with a machinist mate in charge of each. One squad was in training for water tenders and was in charge of a chief water tender; seven squads were in training for firemen and each squad was in charge of a water tender.

Diagrammatically expressed, the organization was made up as follows:



Each engine room squad of six men was made up of two men in training for engine drivers and four men in training for oilers. The ship's oilers were utilized as instructors on watch, but not as squad leaders. In conducting the training the squad system was adhered to throughout.

Depot Divisions Established

When the scheme was first put into operation each ship was assigned a Depot Division. Each battleship division in squadrons three and four were assigned two training ships for the purpose of transfer and receipt of men. The trained men were sent back to the Depot Division ships, which in turn transferred them where needed. A steady inflow of recruits was supplied to the Depot Ships, to supply the needs of the training ships.

Recruits without previous experience were sent for training as firemen, firemen of naval experience were sent to be trained as water tenders, while recruits having mechanical experience in civil life were sent for training as oilers and engine drivers. The latter term was devised to supply men who could operate machinery. It was thought that men could be made available for the specific duty of handling an engine much more quickly, if their training was confined to this particular subject. It was realized that any attempt to train men for general duties in the engine room would require a great deal more time than was available. The need for men was urgent and pressing.

Recruits of Marked Intelligence

Much of the success of the training was directly attributed to the fact that the recruits were men of an unusually high order of intelligence, nearly all of them having enlisted for voluntary service upon the outbreak of war. Many excellent mechanics were enlisted under the rating of machinist mate, second class, and, while they had no marine experience, they made excellent progress. Among the firemen were found many men who could have been enlisted as machinist's mates. Most of them, however, had rushed into the service in any rating. No difficulty was experienced in obtaining men for the engine room branches, but it was soon found that the supply of firemen of experience for training as water tenders was running low. A water tender can learn his regular duties without much difficulty, but experience in fireroom mishaps is essential as an element of safety. In training new men for this rating it was decided that they would not be rated, but a notation made in their records that they had been trained for this work.

The men showed the greatest enthusiasm for their work. They realized that everything possible was being done to instruct them in their future duties; that they would soon be cast upon their own responsibilities and would be expected to produce results. Men who received a certain mark were recommended for one higher rating; in some cases men of unusual ability were jumped from third class firemen to oiler, machinist mate second class or firemen first class. After a new draft had been on board one week and some knowledge of the personal qualifications of the individuals had been obtained, it was necessary to shift a few men about so as to give them an opportunity to qualify for the more expert ratings, while some men in training for the higher rating were shifted to the firemen squads.

Repair Work During Night Watches

During the first months of training the ships got under way at dawn and steamed until sunset, banking fires over night. On the *Alabama* all repair work was undertaken during the night watches. Feed pumps were opened, condenser tubes repacked, bearings adjusted, and everything closed up before four A. M., when steam was turned on the main steam line for warming up. We welcomed the opportunity to repair something and required the men under training to do all the work under the supervision of the petty officers. It is surprising how quickly a man can learn to do something if he is allowed to do it. While under way all the firing was done by the men under training under the supervision of the squad leader. The water was tended by the men under instruction for that rating, under the supervision of the squad leader, a chief water tender. The engines were handled and oiled by new men. It was difficult to persuade the old men that they must allow the recruits to do everything, but they finally got the idea, and later rather enjoyed it.

On a Monday morning after the receipt of a new draft the ship would be got under way by an entire crew of green men. Sometimes, upon getting under way, a signal of one-third speed ahead, followed by another of two-thirds ahead, and another of standard speed would be received from the bridge before the student could get the engine turned over. But no one was allowed to interfere, and unless the situation on the bridge was known to be urgent they were allowed to wait and suffer the delay. It must be said that the commanding officers made the best of the situation, and, while regretting the subordination of the military mission of their ships, lent their heartiest co-operation to the engineer officers.

As the interned ships were completing their repairs, the Depot Ships were discontinued and the men sent directly to the receiving ships. Each draft was detailed specifically for the ship to which it was going and the interest ran high. It was necessary in self-defense to obtain and post all data available on the ships in question to satisfy the curiosity of the men. By so doing it lent interest to the training. When the *Vaterland,* now the *Leviathan,* was commissioned, each man wanted to be sent to her. When there was no objection, each of the top men in their squads were allowed to ask for the ship they wanted, and their request was granted, if possible. The men in the deck force commenced going to the mast, requesting to be put in the training draft. Some of these requests were granted.

Men Sent to Camps at Navy Yards

After the commissioning of the interned ships, the men who completed the training course were sent to the camps at the various navy yards. The new drafts were received directly from the receiving ships and this method was steadily followed.

As stated above, the training ships operated during the day only during the first months of training. Later, however, all ships operated with the fleet, and the training afforded the men below, while not so good for the engine drivers, was better for the firemen, oilers and water tenders, inasmuch as the ship was operating under condi-

tions more closely approximating the conditions the men were to meet. It gave the firemen experience in cleaning fires, which was not necessary when fires were banked each night. At the same time the upkeep diminished rather than increased, as might have been expected from the nature of the work upon which the ship was engaged.

The watch standing was supplemented by instruction periods, twice a day for the men not on watch. The schedule was so arranged with regard to the watches that all men in training for the same rate received the same instruction.

The following courses of instruction were given. These were supplemented by lectures on naval usages and customs of the service:

COURSE OF INSTRUCTION

ENGINE DRIVERS AND OILERS

Feed Water Supply

(1) Height of water—methods of ascertaining.
(2) Supply of feed water—how obtained.
(3) Action necessary at failure of feed water.

Main Engines

(1) Throttle valve, butterfly valve, by-passes, bleeders.
(2) Reversing engines, link gear and cut-offs.
(3) Cylinder drains and relief valves.
(4) Gage board.
(5) Bearing, main, thrust, and steady. Sterntube.
(6) Piston rods, valve stems, crossheads, gibs and guides.
(7) Engine and fire room telegraphs and counters.
(8) Vacuum and loss of same.
(9) Oil—grades used for different purposes.
(10) Oil service and water service.

Main Engines and Auxiliaries

(1) Feed pumps, main and auxiliary.
(2) Air pumps, circulating pumps and condensers.
(3) Feed heaters, separators and traps.

Feed and Steam Lines

(1) Feed tanks, reserve tanks, pumps, connections, feed lines, main and auxiliary.

Ship's Drainage, Fire Main and Flushing System

WATER TENDERS AND FIREMEN

Boilers and Fire Rooms

(1) Coal tally and passing coal.
(2) Priming, lighting off, steaming level.
(3) Firing.
(4) Cleaning fires and ejecting ashes.
(5) Care of bilges and strainers.
(6) Feed water—height of, supply, how obtained, action necessary for failure of water.
(7) Bunker gases—safety precautions.
(8) Time firing device.

Feed Lines

(1) Feed pumps, main and auxiliary.
(2) Feed heaters, separators and traps.
(3) Feed tanks, reserve tanks, pumps and connections.

Ship's Drainage and Flushing System—All Boiler Connections and Fittings

(1) Safety valves, feed checks and stops, bulkhead stops.
(2) Steam traps and cut-outs.
(3) Water columns and try cocks.
(4) Drums, handholes, manholes, door casings.

Each subject was developed by a questionnaire for the use of the squad leaders, and there is in use on board at the present time three pamphlets, one for each course. An example of one of these lessons is given below:

COURSE FOR ENGINE DRIVERS AND OILERS

Lesson No. 12

	Subject	*Reference*
1.	Feed Water System	Ship's Installation. Eng. Handy Book, pp. 85, 155, 158 and 161.

Questions may be made up for this lesson from references given.

Q.—Describe the following parts of the feed water system, including the material of which they are made.

How do they operate?
How are they connected to other parts?
How are they cleaned?
What care and preservation is required?
What troubles are encountered?

1. Reserve feed tanks
2. Feed tanks.
3. Feed tank filters.
4. Feed pumps.
5. Feed heaters.
6. Grease extractors.
7. Feed lines, main and auxiliary; expansion bends.

Q.—What is back pressure? Where is it used? How much is carried? How is it regulated? What is a hot well? Where is it? Why? What is in it? Why? How often are filters cleaned? Trace the main feed line from the feed tank to the boilers, naming all the valves, pumps, expansion bends, connections and cross-connections and other auxiliaries in the line. Why are there two feed systems? Tell where they are and what cross-connections are between these two lines. When would you cross-connect them? How would you put feed water into the reserve tanks? How would you get it out?

The course was developed on the *Alabama* into the series of lessons of which the above is an example. They were made as simple as possible in order that all might understand them. The course as published is in use on all the training ships. Each ship has developed the subjects, while several have adopted the *Alabama* pamphlets.

At the conclusion of the course a page was inserted in the enlisted record of each man, giving the following information:

INTENSIVE TRAINING—ENGINEERS

(C-in-C Letter No. 1885 of 4-24-17)

Trained on board U. S. S. .....
Name .....
Actual rate .....
On transfer from U. S. S. .....

Instructed as .....
General proficiency .....
Qualified as .....
Type of boiler .....
Type of engine .....
Lubrication of engines .....
Fuel .....
Received from U. S. S. .....
Date received .....
Transferred to .....
Date transferred .....

The training has been in operation for about fifteen months at the time of writing this article. Approximately 16,000 men were trained in this time. These men are now doing duty on all types of ships, including battleships, cruisers, transports, destroyers, yachts and submarines. On a recent trip abroad the writer had an opportunity of questioning a great many of the men who had passed through the training course. Many of them had been

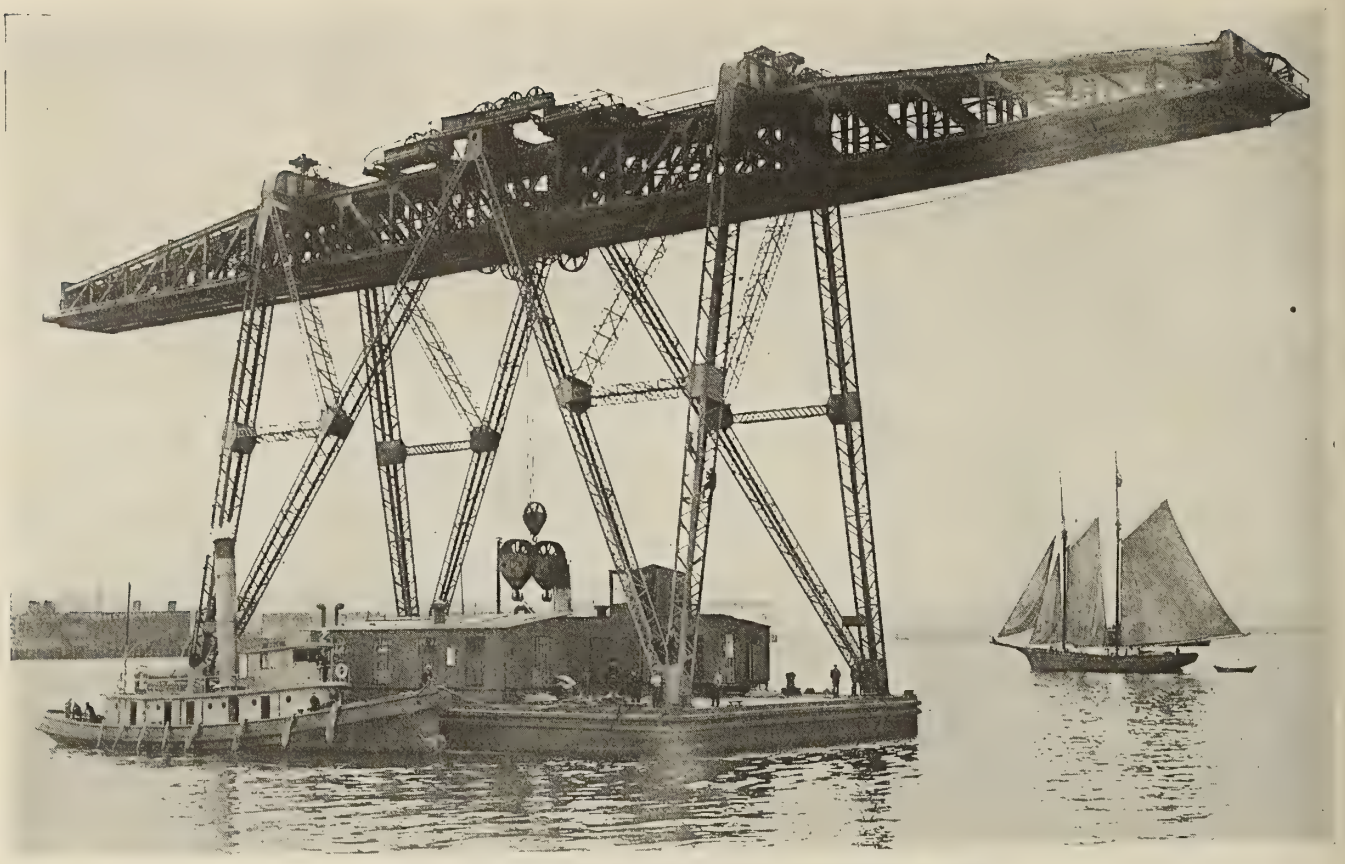


Fig. 1.—150-Ton Pontoon Bridge Crane in Operation at Boston

advanced in rating. This is the best indication that their training had been satisfactory. The reports received from the officers who were working with these men were very satisfactory.

What was a great problem at the beginning of the war has been solved in a very simple manner. If it had not been satisfactorily solved, it is believed that the Navy would have been seriously hampered in its operations. The absence of fireroom and engine room casualties must indicate that these men who have come into the Navy since the commencement of the war have been making good. The officers who have had a part in this work can feel that they have contributed directly and effectively towards the excellent showing of the Navy during the past year.

150-Ton Electrically Operated Pontoon Crane in Operation at the Boston Navy Yard

EUROPEAN ports have long recognized the utility of the floating crane, and it has been used extensively in all the larger harbors of Great Britain and the Continent. But in America the merchant marine developments have hitherto been so small in proportion to our general industrial growth that the use of the pontoon crane in this country has been limited largely to the needs of the Government in connection with naval work. The variety of uses to which this type of crane can be put, however, should cause it to appeal strongly to all harbor authorities on this side of the Atlantic.

Besides being used for lifting, handling and moving of heavy guns, turrets, armor plates, etc., to and from battleships without the necessity of running into dry dock, the pontoon crane can be and has been used with decided advantage for raising small sunken craft, such as tugs; for launching moderate-sized boats; for lifting them out of the water, for scraping; for fitting out ships; for placing boilers in launched hulls; for extraordinary lighterage

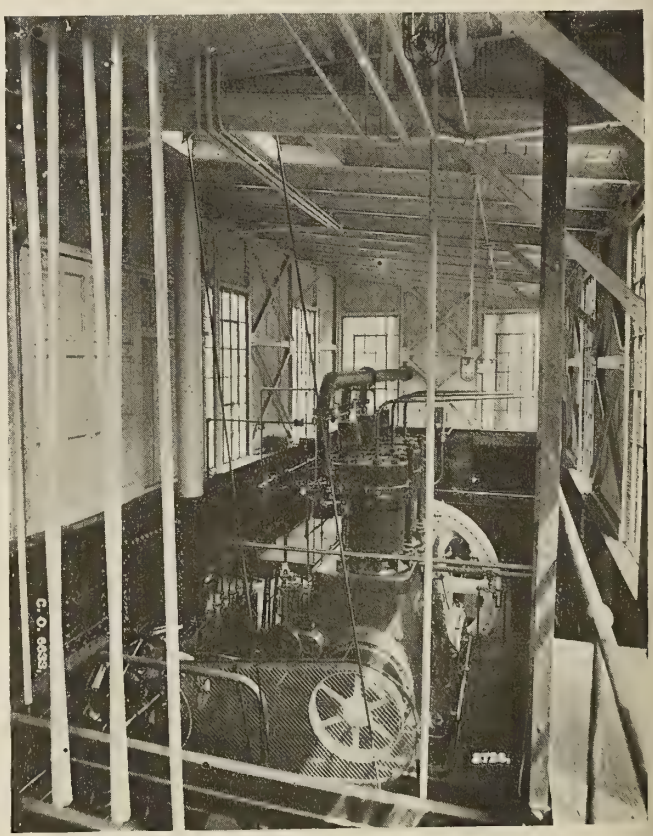


Fig. 2.—Electric Generator Driven by Diesel Engine on Pontoon Crane

problems, and, in fact, for any service where heavy lifting is required on or around docks or anchored vessels. These cranes will also be found invaluable for handling equipment for the large vessels to be constructed in this country during the next few years.

The majority of American-built floating cranes are of the bridge type. These machines admirably fulfill the purposes for which they are designed and have the advantage of being considerably less expensive than the revolving type. Fig. 1 shows a 150-ton electrically operated bridge type pontoon crane in Boston Harbor. This crane was built by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for the Boston Navy Yard.

The two main hoists of this crane have a capacity of 75 tons each, and the auxiliary hoist a capacity of 15 tons. The main hoists run on separate runways and can be used simultaneously or separately. The vertical speed of each is 7 feet per minute loaded, and 200 feet per minute unloaded. The horizontal speed is 100 feet per minute.

The pontoon, or float, on which the crane is installed is 120 feet long, 70 feet wide and 14 feet deep. Eight counterbalance tanks are provided, four at each end of the pontoon.

Power for operating the crane is supplied by generator sets driven by Diesel oil engines, one of which is shown in Fig. 2. Besides this the crane has a large equipment of Edison storage batteries, which make possible emergency operation at any time without outside power. Through cable connections, electric power can also be secured from the shore.

Marine Turbine Governors

BY P. M. ROBINSON*

IT is hard to conceive of a more constant power load than that obtained on the propelling unit of a ship at sea in fair weather. The weight and resistance of the ship cannot be changed, nor can the dimensions of the propeller be altered. So hour after hour and day after day the load to be carried by the engines remains uniform.

A governing device to prevent the machinery from overspeeding is practically unnecessary except to guard against the possibility of breaking a shaft or dropping off a propeller, either of which occurrence is rare.

However, in bad weather we encounter an entirely different situation. With the ship rolling and pitching the propeller is often thrown partially or wholly out of the water, thus relieving the entire load from the engines and allowing them to accelerate rapidly and perhaps reach dangerous speeds.

In the case of a reciprocating engine with all its moving parts, the first symptoms of racing are immediately apparent, and it is the usual practice to station an engineer at the throttle to keep the speed within safe limits.

In the case of a turbine the first indications of racing are not so apparent to the watch engineer, because there are practically no moving parts in sight. The only evidence of an increase in speed is a change in the sound and vibration of the unit, from which it may be difficult to judge what the safe limit really is. Nevertheless, the danger of wrecking a turbine through overspeeding is just as great as the danger of wrecking the reciprocating engine under similar conditions.

To guard against this hazard the majority of marine turbine builders install on their machines an automatic tripping device, which is set to shut off all steam to the

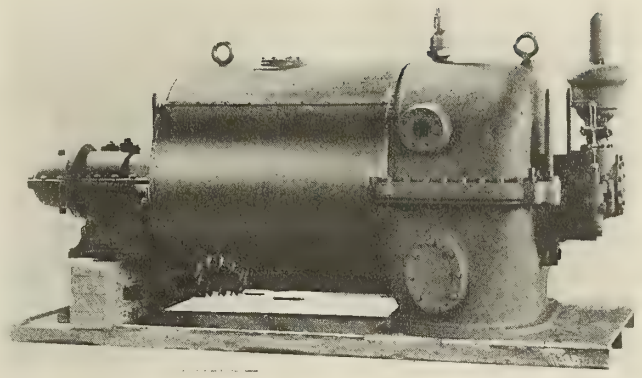


Fig. 1.—Complete Turbine, Showing Governor and Relay Valve at Right-Hand End

turbine when the speed reaches a limiting point of 10 percent or 15 percent above normal. This stops the turbine entirely, and in order to start up again the trip must be reset and the steam valve opened.

Undoubtedly such a device thoroughly protects the turbine from damaging itself by racing, but there are certain contingent disadvantages which make it very undesirable. Chief among these is the possibility of having the turbine shut down even for a short time during a storm, when the loss of steerageway may throw the ship into the trough of the sea with the very possible result of foundering. For this reason a great many chief engineers prefer to disconnect the tripping device entirely, and leave the turbine with no protection at all rather than take the chance of jeopardizing the safety of the whole ship.

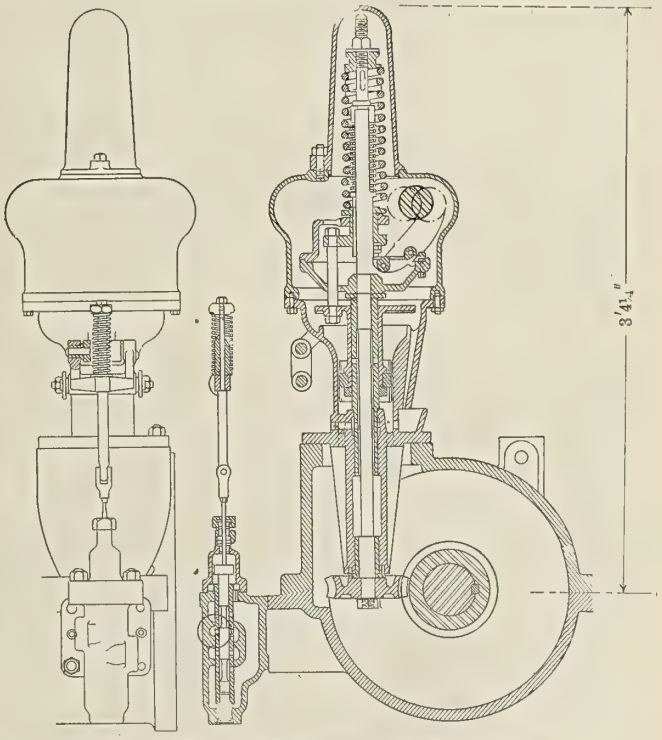


Fig. 2.—Details of Governor and Relay Valve

All Westinghouse marine turbines are fitted with governors, which under no circumstances will shut the turbines down completely, but which will regulate the flow of steam to the nozzles in such a manner that the speed is kept practically constant under all conditions.

The arrangement consists of a vertical spindle mounted on the forward end of the turbine, driven by a worm wheel from the main shaft at a speed of about one-quarter of

* Marine Department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

that of the main shaft. At the top of this spindle is mounted a fly ball governor of the familiar type, the motion of which is transmitted through a system of levers to a small steam relay piston valve, which in turn regulates

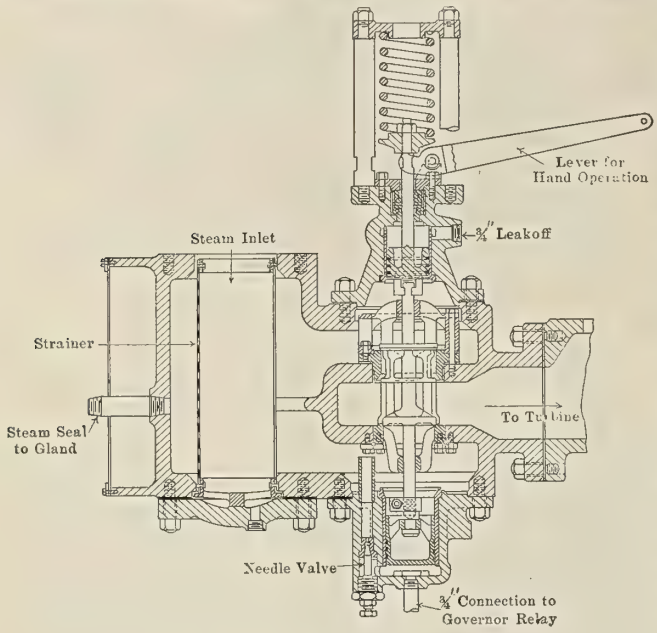


Fig. 3.—The Governor Valve

the flow of steam to the operating cylinder of the main governor valve.

As the speed of the turbine increases above normal, the governor weights are thrown farther away from their center of rotation by centrifugal force and the steam relay valve is moved a corresponding amount. This opens up the steam ports, which exhaust the steam from the bottom of the governor valve operating cylinder, producing an unbalanced condition, and the governor valve starts to close, slowing down the turbine. But as soon as the speed is reduced to normal the governor weights return to their former position, moving back the relay and reopening the governor valve.

While no attempt is made to obtain extremely close regulation, such as is needed on electric generator drives, it has been found that the marine governors are very positive in their action and hold the speed of the turbine within very reasonable limits.

The chief engineer of a Westinghouse installation recently reported that in bad weather, with the vessel loaded, the turbines did not vary more than 2 percent above or below the normal revolutions per minute, and with the vessel running light the maximum variation recorded was only 4 percent above or below.

New Floating Dry Dock for Savannah

THE first pontoon of the new 8,000-ton sectional floating dry dock for the Savannah Dry Dock & Repair Company, Port Wentworth, Savannah, Ga., was successfully launched at the company's yard on April 15, 1919. Since then three other pontoons, of the total of six, have slid into the water.

The pontoons are of wooden construction, but are designed and constructed so that when the pontoons are joined together they form a single, rigid unit. This rigidity is due to longitudinal, pin-connected trusses, a patented feature of the designers, which form an integral part of each wing and which overcome the objection to the ordinary wooden sectional floating dock—its excessive flexibility.

The photographs show the simplicity and accessibility of the pin connections which join the pontoons and the truss members. Each pontoon is 63 feet in length, which, with the fantails of the end pontoons, form a dock capable of handling vessels up to 480 feet long and 8,000 tons displacement.

The pumping machinery consists of twenty-four electrically operated pumps, four in each pontoon, the control of which is so arranged that all will be operated from a central house on shore. On the end of the dock op-



Fig. 1.—Second Pontoon Launched at Savannah Dry Dock & Repair Company, Port Wentworth, Savannah, Ga., April 19, 1919. Fantail Section of 8,000-Ton Crandall Dock

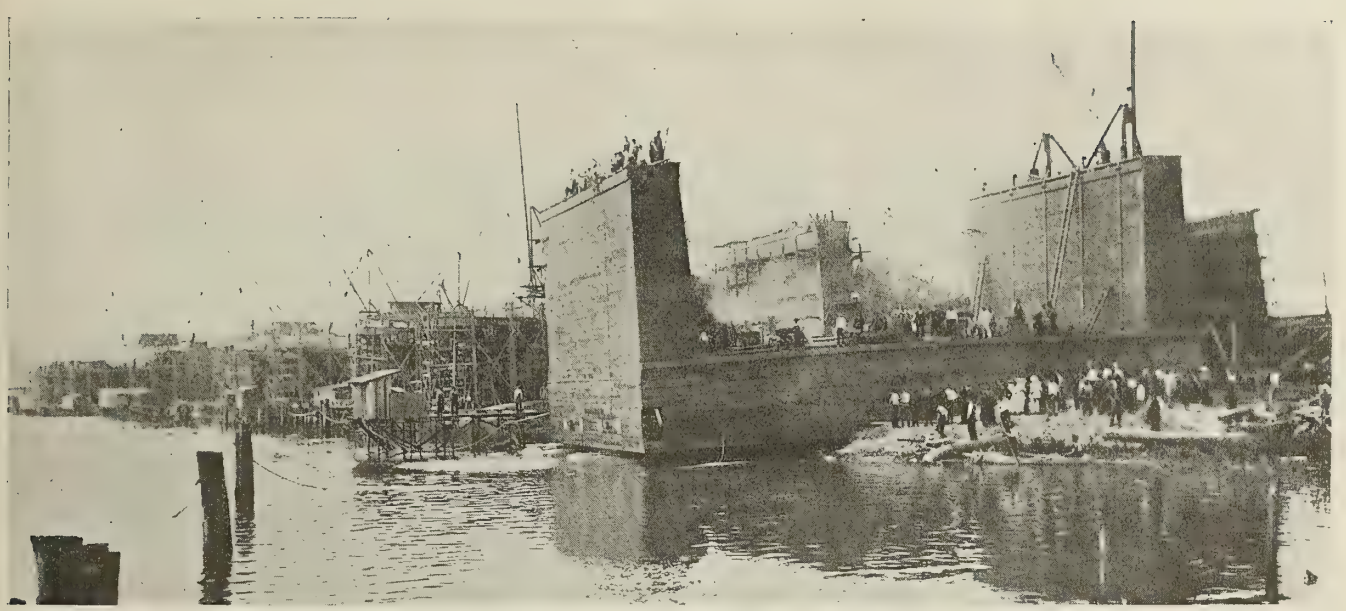


Fig. 2.—First Pontoon Launched at Savannah Dry Dock & Repair Company, Port Wentworth, Savannah, Ga., April 15, 1919. Intermediate Section of 8,000-Ton Crandall Dock. Two Ways, Each 2 Feet Wide, 5/8-Inch Declivity. Distance from Outboard Perpendicular to End of Ways 98 Feet. Grease Used, Stearine, Tallow and Graphite. Perfect Launching

posite the control house will be a water register for showing the height of water in each compartment of the dock, thus enabling the dockmaster properly to regulate the pumping of the dock compartments to suit the ship.

Releasing bilge blocks operated by winches on the wing walls of the dock are employed throughout.

The dock was designed by The Crandall Engineering Company, dry dock engineers, East Boston, Mass.

The Heine Marine Cross Drum Boiler

Marine boilers of two types have been built by the Heine Safety Boiler Company in their plants at St. Louis, Mo., and Phoenixville, Pa.—the "longitudinal drum" type and the "cross drum" type. The former is built on the lines of the well-known Heine watertube boiler and the earlier ships were fitted with these, but the later and by far the greater number of ships have received boilers of the "cross drum" type, which has shown itself so superior for the peculiar and exacting marine service that it is now the standard Heine marine watertube boiler.

The boiler proper consists essentially of three pressure elements joined together by a multiciplicity of tubes. These elements are two flat rectangular box headers and a cylindrical steam drum as shown in Fig. 1. The main bank of tubes extends between and connects the two box headers, which are set with the flat surfaces a certain distance apart. The connecting tubes are all of the same length, straight and parallel with each other, and when this part of the boiler is set in operating position are inclined at an angle of sixteen degrees to the horizontal. Above the front box header and slightly to the rear of it is placed the steam drum, which is connected to the front header by a row of nearly vertical short tubes or nipples and to the rear header by a row of longer tubes, which are horizontal when the boiler is set. The boiler proper, made up of drum, box headers and tubes, is supported by a strong, rigid,

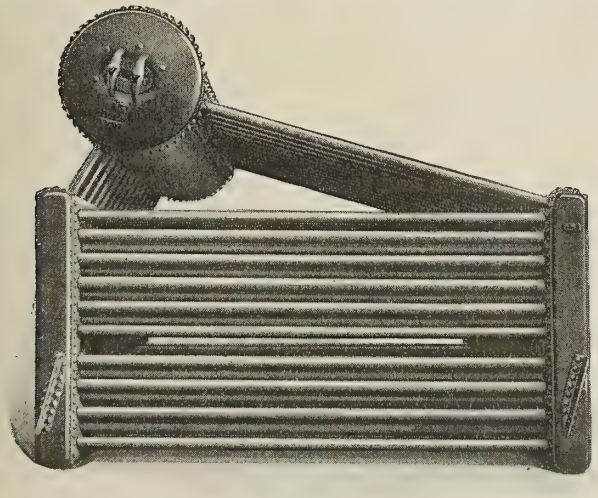


Fig. 1.—Headers, Tubes and Drum

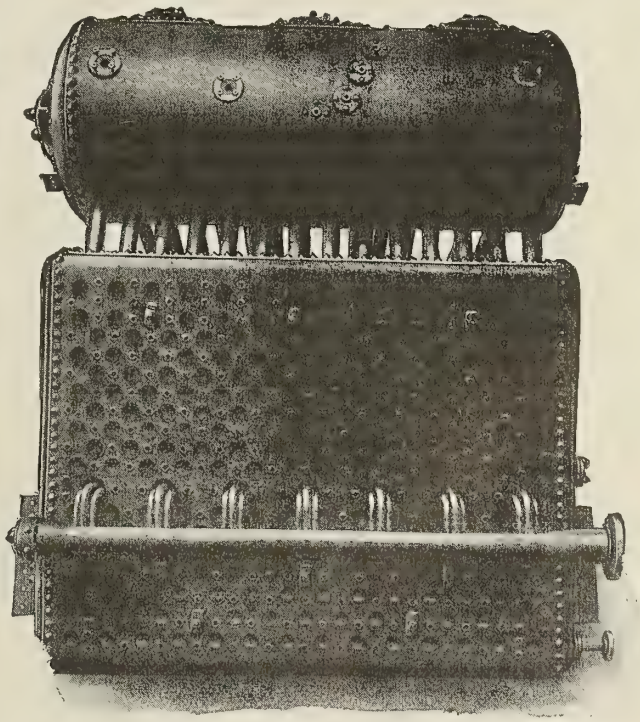


Fig. 2.—End View of Boiler, Showing Superheater Elements

steel structure resting on and secured to proper foundations in the vessel—partly shown in Fig. 3.

Steam Drums

The steam drum is cylindrical and varies in the several sizes of boilers from 36-inch to 48-inch in diameter. It consists of a single plate steel shell of a thickness corresponding to the pressure requirements, rolled to a true circle, fitted with a double-riveted, double butt-strapped longitudinal riveted seam, and at the ends with flanged and dished steel heads which require no braces. In one of these heads is arranged a flanged-in manhole for access to the interior of the steam drum. Where the tubes enter and are secured to the shell of the drum, reinforcing plates

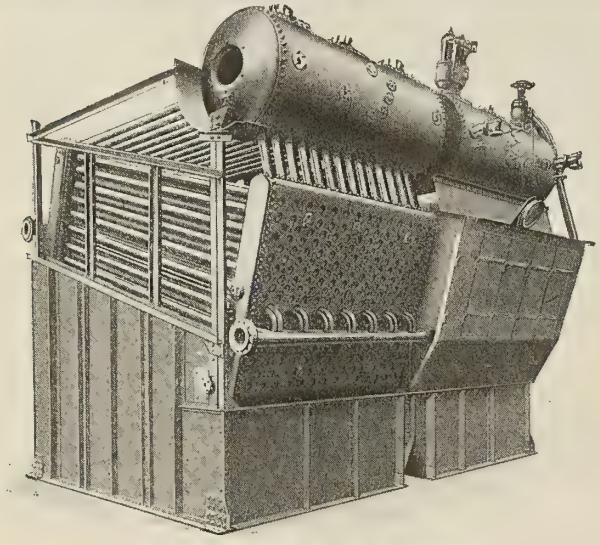


Fig. 3.—Boilers Partly Assembled

are fitted. On top of the drum are fitted heavy pressed steel saddles for attaching the main stop valve, auxiliary stop valve and safety valve.

To the front side of the drum shell are riveted pressed steel flanges for attaching the main and auxiliary feed check valves, surface blow valve, two water gage glasses and three test cocks.

Drum Fittings

Inside the drum, properly secured to the shell and firmly braced in position, is fitted a steel deflection plate. This plate is of sufficient length to cover the ends of the horizontal tubes and extends below the water level, its purpose being to act as a separator for the mixture of steam and water entering the drum through the horizontal tubes. Water thrown violently against this plate runs downward into the body of water below, and the steam passes along and around the ends of the plate and to the dry pipe above.

An internal feed pipe is fitted between the feed check valves. This is perforated in order to distribute the entering feed water uniformly through the water already in the drum to avoid producing undue strains. The same pipe is connected to both checks.

A scum pan of the usual "dish" type, with its cover plate slightly raised to produce an efficient "skimmer" effect, is located at the center of the drum exactly on the water line and piped to the surface blow outlet on the front of the drum shell.

Surge plates are fitted to check the rush of water along the drum as the vessel rolls in a seaway. These plates, together with the deflection plate, make a substantial structure for supporting and securing the various fittings within the drum.

The main steam outlet is provided with a dry pipe of ample area. This pipe is fitted as near the top of the drum as practicable, and has slots cut through its upper side, the area through these slots exceeding the area through the outlet opening. Calorimeter tests show that the Heine marine boiler thus fitted delivers steam containing less than three-quarters of one percent of moisture.

Installation of Zinc Slabs

Zinc slabs are also fitted in the drum of the boiler. The Navy standard of three-quarters of a square foot of exposed zinc plate is provided for each one hundred square feet of heating surface of the boiler. These zinc plates are secured so as to give close metallic connection with the metal of the boiler and yet allow easy renewal. A pressed steel "basket" is also fitted to catch the disintegrated zinc.

The box headers are constructed entirely of steel plate. Each consists of two flanged rectangular heads or end plates to which are riveted a wrapper plate in two pieces. These headers are so designed that all seams are readily accessible for inspection and recalking without tearing away the boiler casing. The end plates are flanged by hydraulic pressure at a single heat and are of the exact shape desired. The two wrapper plates, known as the tube-sheet and handhole sheet, have their edges turned over at the top and bottom of the headers, lapped and riveted together with a single row of rivets, with the calking edges facing outward. The flat surfaces of the tube and handhole sheets are truly parallel with the handhole exactly opposite each tube hole, thus permitting access to the tube for cleaning and withdrawal of the tube through the handhole when necessary.

The two flat surfaces of the box headers are stayed to resist internal pressure with large hollow steel staybolts screwed through tapped holes in the plates and with the projecting ends of staybolt riveted over on the outside.

The staybolts are threaded only at the ends, leaving a smooth cylindrical shank within the water space, thus offering no sharp edges or grooves to the corrosive effect of rust. Each staybolt has a hole throughout its entire length of ample size to pass freely a ⅜-inch pipe lance for soot blowing.

Supporting Lugs

Forged steel tee bar lugs (see Fig. 1) of heavy section, about 24 inches in length, are riveted to the outside of each flanged end plate of the headers for attachment to the supporting columns of the casing structure. The flat bases of these tee bar lugs are calked all around, and the edges are always accessible for inspection or recalking without tearing out any part of the boiler support or setting.

Near the bottom of the front (lower) box header and on one side only (except in extremely wide boilers) is riveted a forged steel flange to which is bolted, with copper gasket in male and female joint, a heavily ribbed and flanged composition blow nozzle or extension pipe to the outer end of which is attached the bottom blow valve. An internal pipe leads to the extreme bottom of the box header and insures removal of sediment deposited therein.

The standard design of Heine marine watertube boiler has 3½-inch diameter tubes throughout. For oil fuel only, the use of 2-inch tubes instead of 3½-inch tubes in the inclined bank between the headers is recommended, and the company builds a special oil-burning marine boiler so fitted. Two-inch tubes are not recommended for coal fuel because of the great tendency of boilers fitted with small tubes, closely pitched, to "soot up" or become choked. Its superior steaming qualities are recognized.

Machinery of the Battleship New Mexico

(Photographs by General Electric Company, Shenectady, N. Y.)

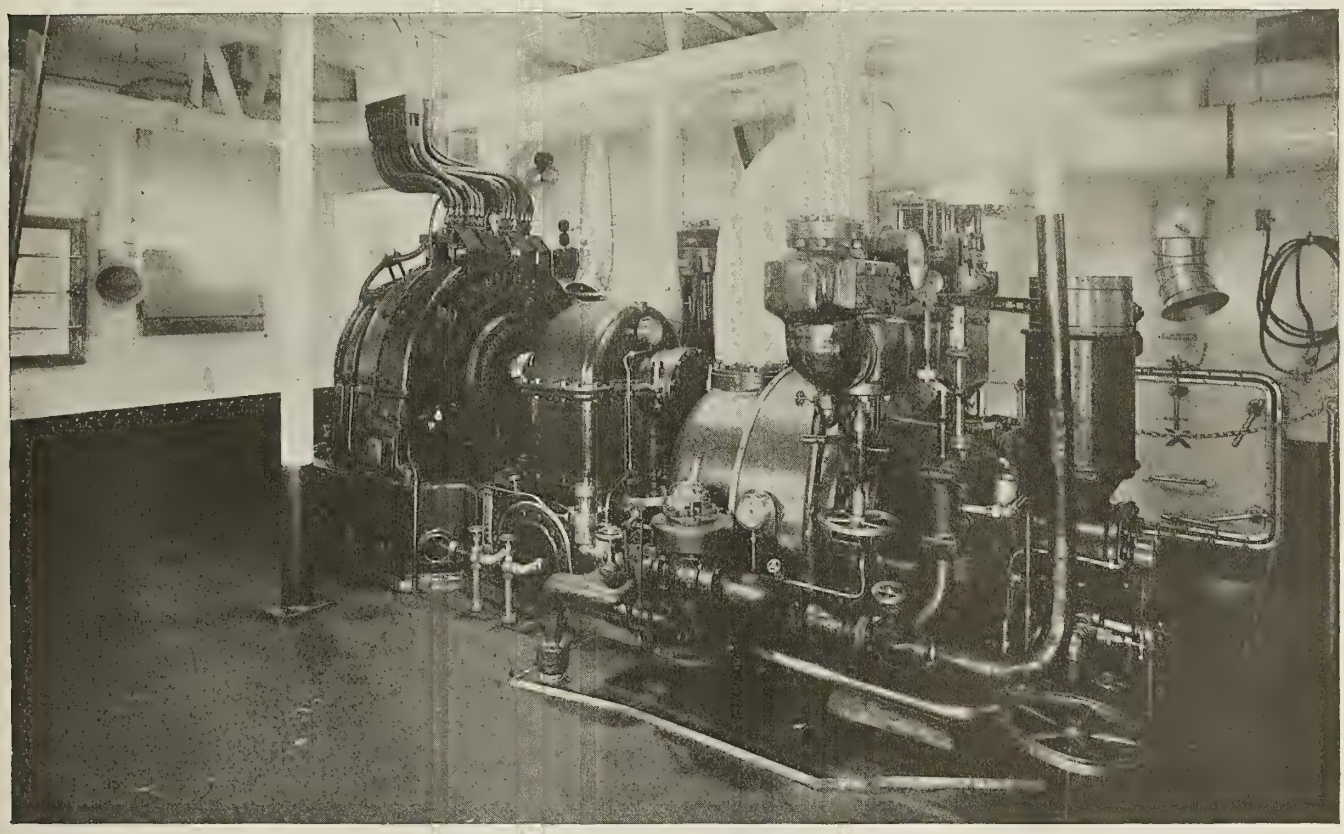


Fig. 1.—One of the Auxiliary Turbo-Generator Sets

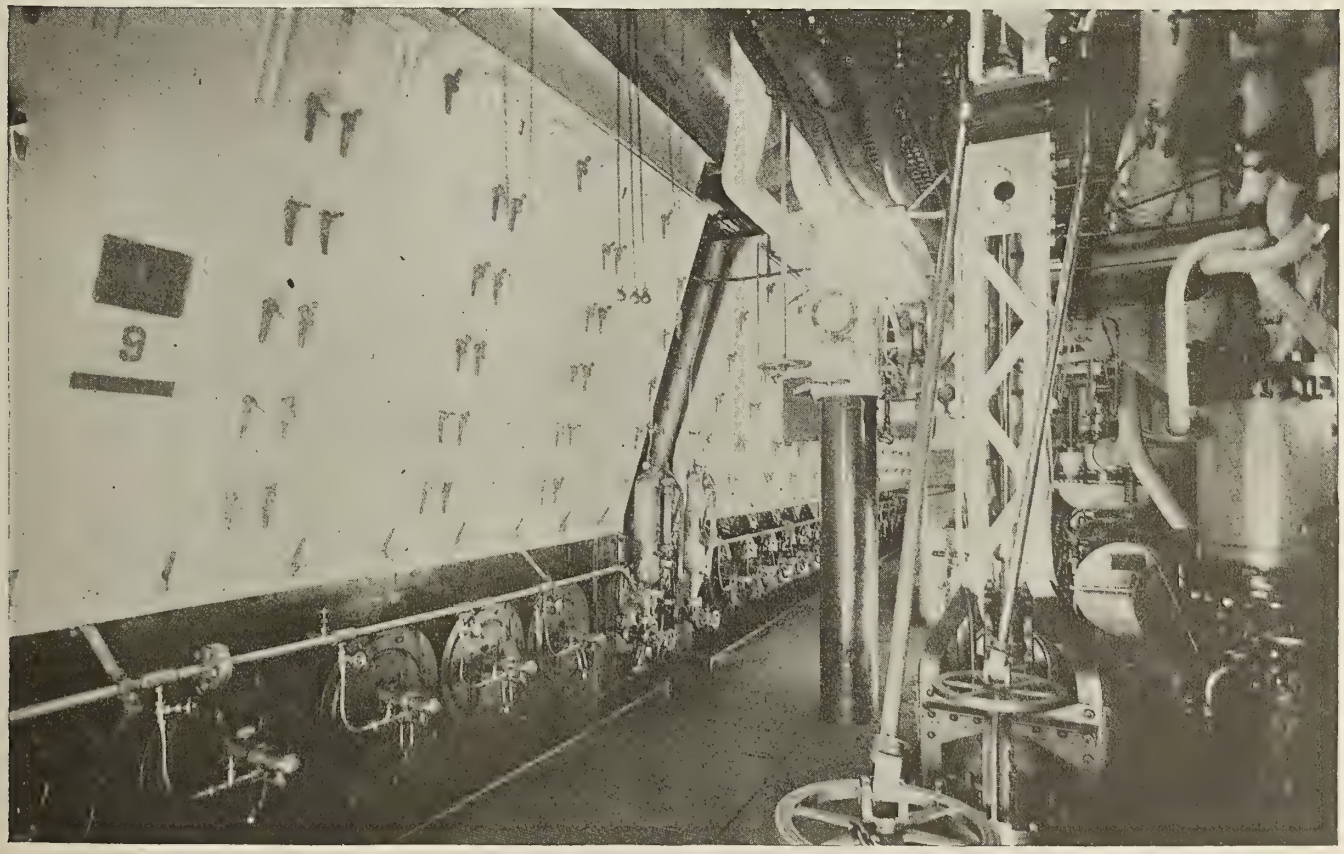


Fig. 2.—One of the Boiler Rooms on the *New Mexico*

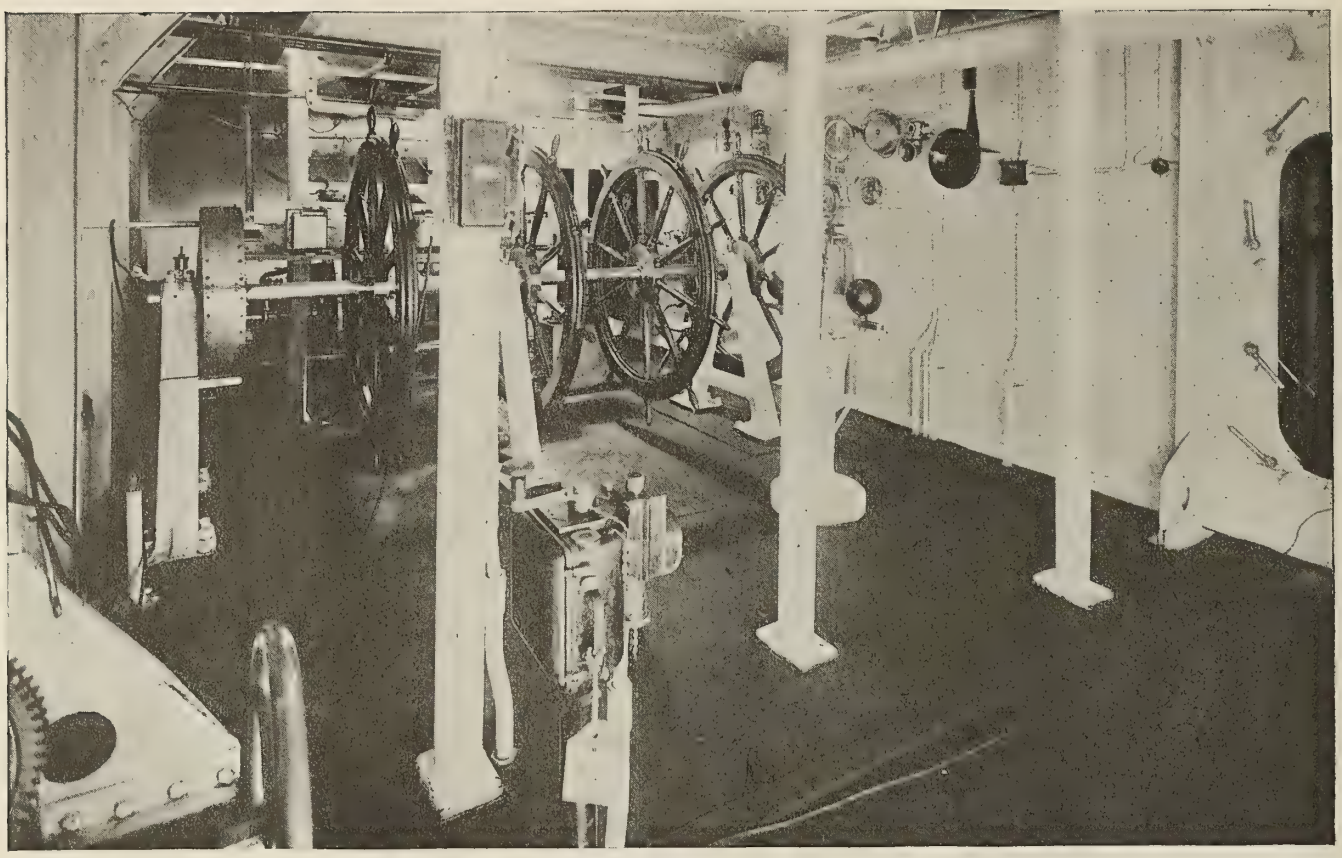


Fig. 3.—Auxiliary Steering Engine Room

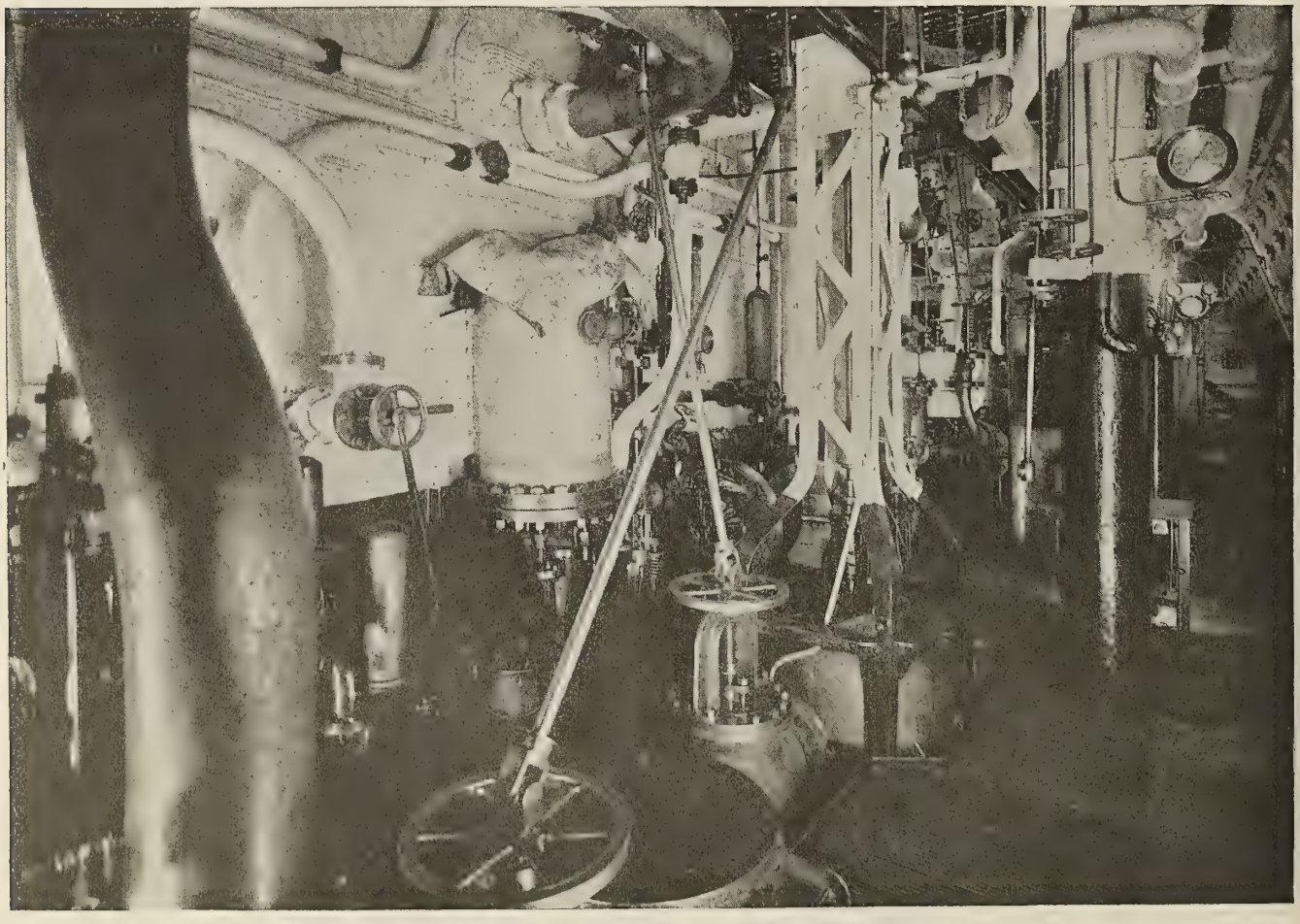


Fig. 4.—Fuel Oil Pumps in One of the Boiler Rooms

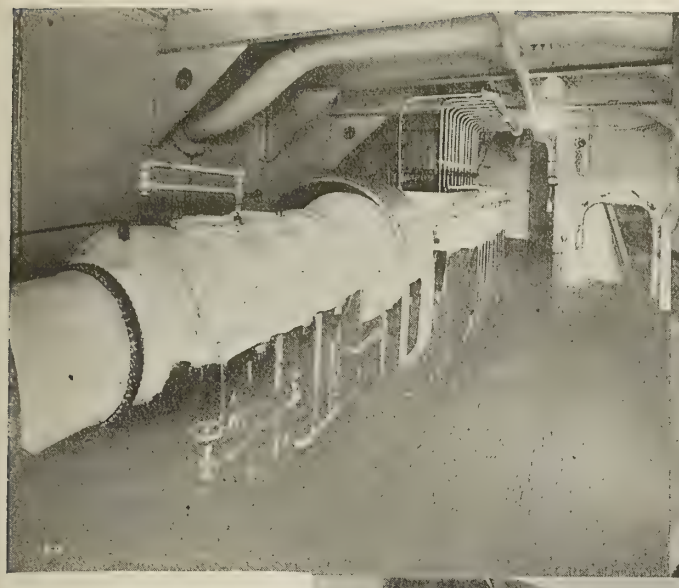


Fig. 5.—Starboard Inboard Propeller Shaft

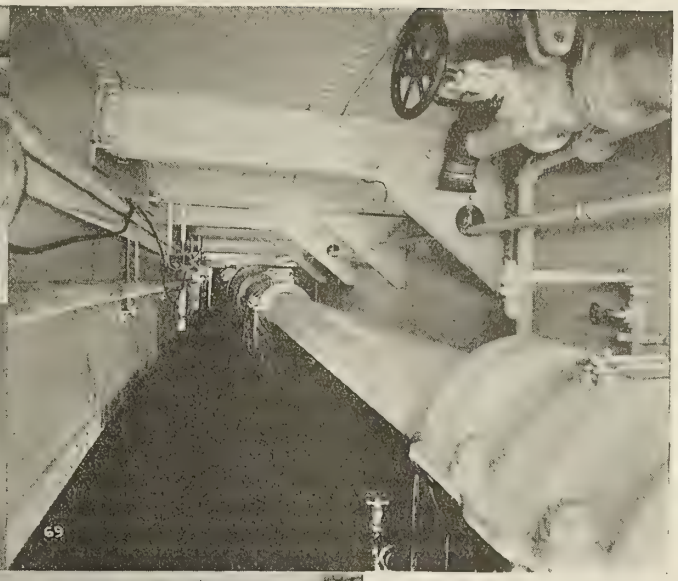


Fig. 6.—Port Inboard Propeller Shaft

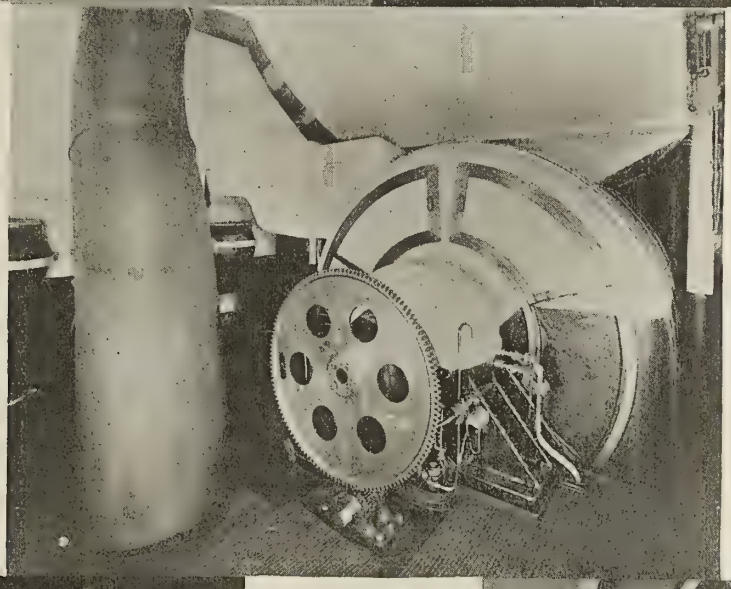


Fig. 7.—One of the Main Turbo-Generators

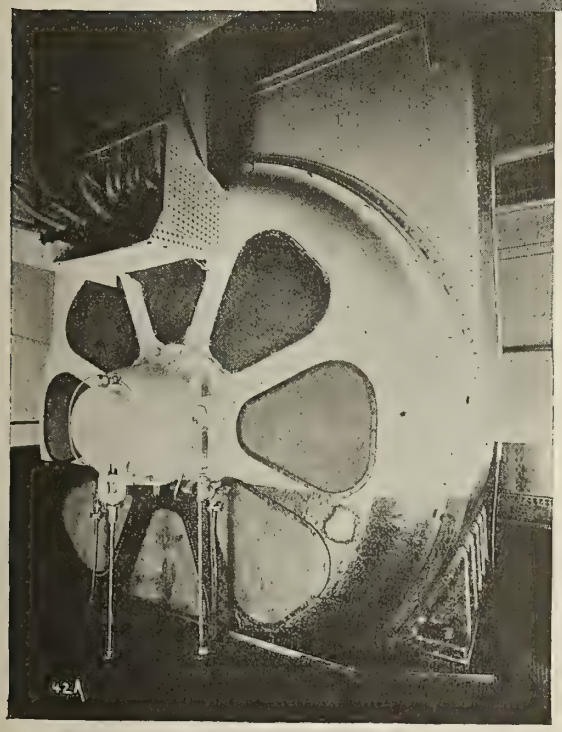


Fig. 8.—Forward End of Propelling Motor

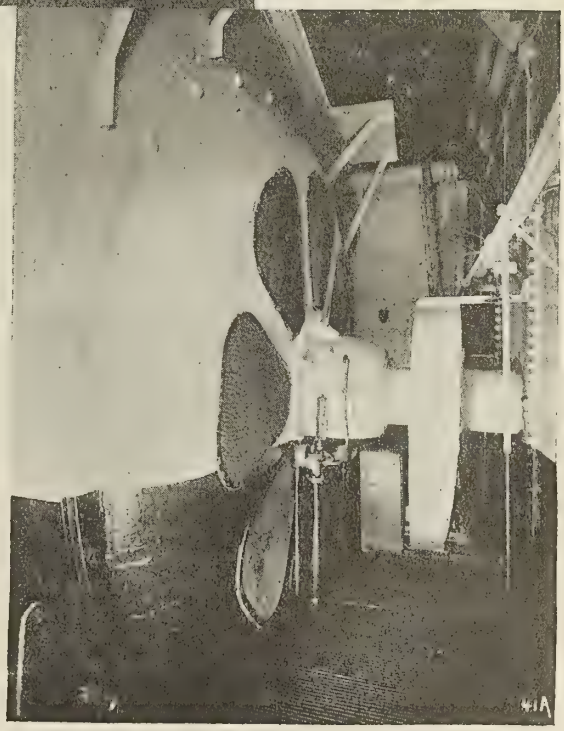


Fig. 9.—After End of Propelling Motor

Motor Trucks and the Problem of Efficient Marine Freight Terminal Operation—III

BY MERRILL C. HORINE

As emphasized in the previous installments of this article, the weak link of our transportation facilities as applied to overseas commerce is not in the railroads or ocean carriers, but in the methods and facilities employed for handling freight at the marine terminals. No one will dispute the statement made by the author in this issue that the American public and American industry want world trade and a powerful merchant marine. But how long will it be before the public wakes up to the fact that there is something wrong with our terminals and that efficient terminals are an indispensible factor if our newly born shipping industry is to survive?—THE EDITOR.

AMERICAN commerce on the high seas is more in jeopardy from inefficient methods in our own ports than it ever was from the exploits of piratical Germany.

Transportation is the foundation of civilization and the pathway of progress. Transportation is a chain, and only as efficient as the most imperfect link. That weakened link to-day lies between the steamship and the railroad or warehouse. Thousand-foot merchantmen, 12,000-horsepower locomotives, 100-ton freight cars and a surplus of low-priced quality manufactures will be our ruin rather than our gain, if this rusty, inadequate, unwieldy link is not replaced quickly with terminal transportation on a par in efficiency with the railroads and steamships it must serve.

Too often generally demanded reforms are impeded by the very inertia of their size. Where a small number of people are concerned it is comparatively easy to overturn precedent; but where practically every element of business is concerned it is difficult for one party to effect concerted action. But in these days the man, or concern, or nation, which says a thing cannot be done is continually being interrupted by someone doing it.

When the great delusion about the United States being splendidly isolated by 3,500 miles of ocean, of a million men accustomed to bear arms springing to arms overnight, and of the independence from Europe of American manufacturers was shattered by the events of the past two years, America learned a few lessons. We awoke from our fatuous dreams and created a great army. We sat up and paid attention to what was going on in this world of which we are a part and took a hand in setting a few things to rights. American industries that had been dependent upon an enemy power for essentials started independent production. We made our own dyes, our own nitrates, and discovered independent sources of platinum.

The American public and American industry want world trade and a powerful merchant marine. We know that something is wrong with our terminals and that efficient terminals are indispensable to export and shipping supremacy—nay, even survival. American industry, in particular shipping and export interests, will either determine what must be done and do it quickly, or some other nation less prone to procrastination will do what we ought to do and capture our trade and our merchant marine.

> "There is no royal road to terminal efficiency, else it would have been traveled long ago. But there is a key to the situation, and that is motor trucks. Big tonnage on the water, big tonnage on the railroads, high speed at both places—these things spell economy because they save both time and labor. To realize their advantages to the full they must be linked up by road vehicles of big tonnage and high speed, as compared with the horse vehicles making their last stand at city terminals today."
>
> —MERRILL C. HORINE.

The Shipping Board has announced that the largest ships afloat are to be built for American commerce and that a terminal with 1,200-foot piers is to be built either at Montauk Point, L. I., or in the lower bay of New York. The city of New York is planning other mammoth terminal enterprises. Will these undertakings be turned over to architects for the development of pleasing proportions and conventional arrangement, or will a real engineering job be made of them? Will they be arranged for the easy-going horse transportation of our grandfathers' day, or with recognition of the imperative needs of the motor transportation that must soon displace the horse at the freight terminal as it is doing or has done in practically every other field?

If the government is to undertake this new construction with the far sight that the situation of America in world trade demands, some fundamental requirements must be met.

Direct railroad connection by at least four-track lines must be possible with one of the larger general yards of the port or with a special union yard adjacent. Each pier must have at least two tracks running its length and with space for cars totalling a capacity ample for one-third of the cargo of the largest ship to use the pier. This will permit the entire carload volume of freight in an average cargo to be transferred direct between the car and the ship's hold at the speed at which the ship is able to load or unload, the train being sorted after loading or before unloading, as the case may be, in a switchyard instead of the present method of sorting or collecting the cargo piecemeal from a score or so of freight yards by means of horse vehicles or lighters.

A reception floor of sufficient area to provide 10 square feet per ton of deadweight cargo capacity of the largest ships to use the pier must be provided and there must be a duplicate of this floor on a different level for collection of outbound cargoes.

In the case of a quay, wharf space equal to one such floor is sufficient, since not more than one ship may berth on its frontage at a time, whereas one may unload on one side of a pier while another is loading on the other.

Slip space wide enough to accommodate ample coal barges to coal ship while loading and unloading at the highest rate of speed which the most improved devices for this purpose permit will be required.

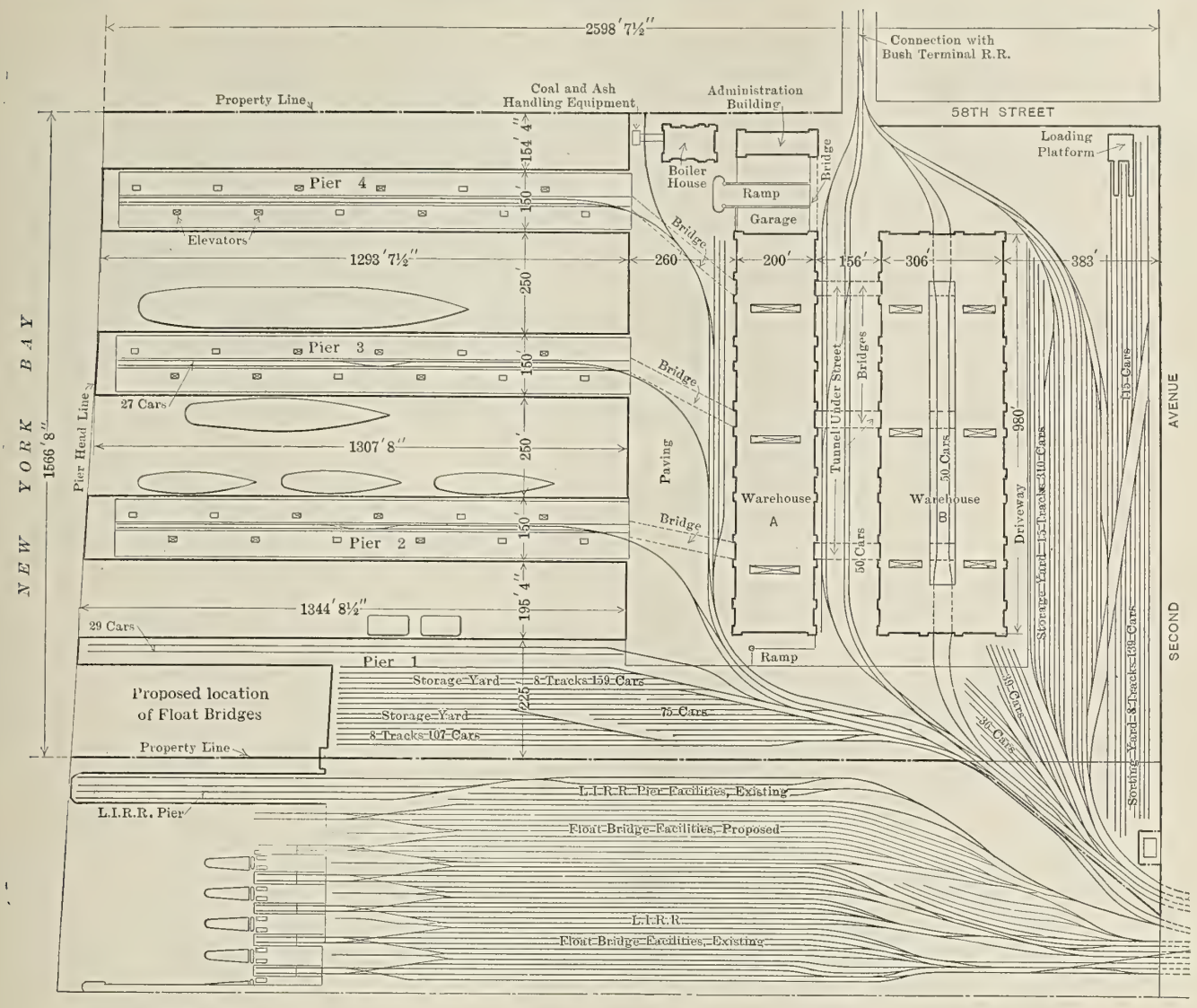


Fig. 17.—Four Piers and Two Warehouses Comprise the Army Base Terminal at South Brooklyn. The First of These Piers Is for Car Floats, the Remaining Three for Steamships. Each Is Approximately 150 Feet Wide by 1,300 Feet Long, Double-Decked and Connected with the Warehouses by Two-Way Bridges. Each Pier Is Double-Tracked Down Its Center and Is Equipped with Six Elevators. They Are Separated by Slips 250 Feet Wide and from the First of the Two Broadside Warehouses by a Paved Bulkhead 260 Feet Deep

Warehouses, either on upper floors of the pier or on the land directly adjacent to the piers, must be provided, each warehouse to be of sufficient floor space to accommodate at least five times the total capacity of all piers included in its frontage. Thus, if the warehouse included three piers in its frontage, each of which has floor space to receive two 1,000-foot ship loads, the warehouse would require floor space sufficient to accommodate thirty such ship loads.

These warehouses should have direct rail connections, sufficient to spot cars enough to handle the freight as fast as the assumed three piers could load it or unload it to or from the ships. Thus, if in an emergency the warehouse were full and freight were moving to it for shipment as fast as the ships were taking it away, or vice versa, and the goods longest in the warehouse had to be moved first, such correlation between the railroad and the ship would make the terminal an efficient link between the two.

The connection between the warehouse and the piers should be by tunnels, bridges or both, so that the interior transportation system could move in and out without crossing the railroad tracks or vehicle roadways. Such connections should be two-way, so that continuous streams of interior carriers could move in both directions.

Vehicular traffic should be restricted normally to the warehouse, which should be provided with space for a sufficient number of trucks to handle double two-thirds of the maximum tonnage possible to load and unload from vessels at the piers. The average vehicle haul from New York terminals is about 4½ miles round trip. However, the spreading-out process that is resulting from better transportation may, and probably will, increase this to as much as 10 miles round trip. At an 80-mile haul a 7½-ton truck is consuming about the normal working day at city traffic speed and fairly good loading efficiency. With 10-mile average round-trip hauls, and estimating 66⅔ percent load factor, or 5 tons each way per trip, each truck would be capable of moving 10 tons to and from the warehouse eight times a day, a total of 80 tons daily.

Ten feet of loading platform space per vehicle should be provided. If the railroad tracks are run along the sides of the warehouse, the vehicle platforms should be within the building, or if the tracks run into the building the vehicle platforms should be along the edges. In each case the loading platforms should be of a height to bring the car or truck floors even with the floors of the interior transportation trucks or trailers, the height of these floors being taken with the springs depressed, as under full load,

since the slight lifting necessary onto an empty car or truck can better be performed to the relatively firm floor of the car or truck than the rather unstable one of the warehouse truck or trailer.

Of the two arrangements of tracks and vehicle platforms, the arrangement involving spotting the cars outside and the vehicles inside is to be preferred, since then the steam locomotives do not smoke up the interior and ramps from the interior driveways can be arranged by which the vehicles may be operated over the floors and onto the elevators of the warehouse, if desired. Where heavy machinery, etc., is involved, this is often of great convenience.

On the piers the best arrangement of tracks is down the center of the wharf, leaving wide floors on either side for the free movement of goods going on and off the ship and for the operation of the warehouse trucks and tractors. For convenient handling of freight between the ship and the railroad cars, cargo masts at the edges of the pier and traveling locomotive cranes are perhaps most effective. The same sling by which articles are raised from the hold of the ship's crane may then be used clear to the side of the car.

This arrangement need not interfere with customs in any way, as the warehouse will be an integral part of the terminal and can be bonded entire. By moving import cargo directly to a receiving and classifying floor of the warehouse, customs inspection can be carried out at leisure and without interfering with the free movement of goods. In this way a bonded terminal can offer many of the advantages of the European freeports, such as Cuxhaven.

An additional advantage of having the vehicle platforms within the warehouse is that the driveways may then be used as a garage for the trucks, with repair shops in direct connection. Thus no time need be lost in running to and from the garage and the nightly or early morning greasing, oiling and inspection may be made while the bodies are being loaded.

In a terminal organization of considerable size, branch receiving and distribution located in the wholesale districts might be advantageous, part of the vehicle equipment being garaged at such branches at night. Thus, trucks loaded with inbound freight might continue to leave the terminal up to the close of the day, completing delivery from the branches the first thing in the morning. Trucks having picked up incoming loads toward the close of the day need only run to the branch that night, completing delivery to the terminal next morning. Empty mileage would be reduced to the minimum.

One of the stumbling blocks in the way of centralized terminal haulage is the question of charges for the service. It has been rather definitely established by the Interstate Commerce Commission that carriers may not absorb charges for service of this nature in the freight tariffs despite the fact that the express companies and the postal service do so. If this obstacle cannot be removed, it is by no means insurmountable. Charges sufficient to pay the cost of the service can be levied on a zone basis and still be so much lower than current trucking rates as to discourage the use of private cartage facilities entirely. Should it be necessary to continue to accommodate such outside vehicles, the warehouse offers practically limitless space for the reception of vehicles and without interfering with the free movement of freight between ships, railroad warehouses and the terminal's own motor trucks.

Perhaps the most difficult problem confronting the plan is the delays which are occasioned by consignees' failing to unload the vehicles promptly and by shippers delaying the loading of outbound matter. This is encountered to a considerable extent by the express companies and improvement in this respect would doubtless effect important economies.

One way to do this would be to follow the practice of the taxicab companies. The taxicab fare is nominally on a mileage basis, but to prevent loss through excessive standing time, an extra charge is made for each 10 minutes of waiting after the first 10 minutes. The railroads allow a reasonable time for a car to be loaded or unloaded and then charge demurrage. Demurrage could be charged to shippers in a similar manner; a minimum free time of 15 minutes for 3 tons and under, and 5 minutes additional for each additional ton being allowed, and 10 cents (0/5) a minute for all demurrage time.

> "Direct railroad connection by at least four-track lines must be possible with one of the larger general yards of the port or with a special union yard adjacent. Each pier must have at least two tracks running its length and with space for cars totalling a capacity ample for one-third of the cargo of the largest ship to use the pier. This will permit the entire carload volume of freight in an average cargo to be transferred direct between the car and the ship's hold at the speed at which the ship is able to load or unload, the train being sorted after loading or before unloading, as the case may be, in a switchyard instead of the present method of sorting or collecting the cargo piecemeal from a score or so of freight yards by means of horse vehicles or lighters."—Merrill C. Horine.

Making marine freight terminals efficient is less a matter of architecture than of method. Present designs of piers in American ports are necessarily based upon present methods of freight transfer. Excepting the more flimsy wooden structures, most of the permanent piers constructed in recent times have the virtue of size and so can be adapted in some measure to more efficient systems of freight movement. Undoubtedly with a change of system, marine terminals to be constructed later on will be designed to harmonize more perfectly with the most modern methods.

But while not the most important factor to efficiency, the design of terminals has a great bearing on the development of methods that are possible. Two of the most efficient marine terminals in America today are the Army Base Terminal in South Brooklyn, N. Y., and the Los Angeles Municipal Terminal at San Pedro, Cal.

That the tendency in construction is distinctly toward more efficient arrangement is indicated by the character of new projects now under construction. Another Army enterprise which is now about completed is the $15,000,000 (£3,060,000) waterfront Army terminal at New Orleans, which has been released for general storage and shipping purposes. It is capable of storing 178,500 tons of freight, or the approximate volume of 10 days' movement over all the public wharves at the port. It comprises three 6-story warehouses, each 140 by 600 feet, adjoining each of which is a wharf house 140 by 2,000 feet, double-decked, and connected with the warehouses by multiple-deck connecting bridges.

A $10,000,000 (£2,050,000) warehouse for foodstuffs in Long Island City, N. Y., is projected, involving warehouses covering 15 acres of ground ten stories high, with



Fig. 18.—The American Dock Company Adopted Troy Trailers for Its Three Trucks in Order to Eliminate Horses from Its Service, the Purpose Being to Haul from 1½- to 2-Horse Wagon Loads per Truck Trip

dockage facilities for ships up to 35 feet draft and equipped with freight elevators capable of raising loaded freight cars.

Trend in Freight Terminal Planning

That the trend in freight terminal planning is distinctly toward more efficient vehicular movement of freight is indicated by the fact that at this Long Island City warehouse the plan is to load motor trucks on the various warehouse floors and transport the freight directly to the doors of wholesalers in the Metropolitan district of New York and New Jersey. The New York Port and Harbor Commission has appointed a committee to study into labor-saving freight-handling devices in connection with the planning of new terminals and improvements in methods at present ones. The same commission is reconsidering the store-door delivery plan.

Army Base Terminal at South Brooklyn

Four piers and two warehouses comprise the Army Base terminal at South Brooklyn. The first of these piers is for car floats, the remaining three being for steamships. Each of these piers is approximately 150 feet wide by 1,300 feet long, double-decked, and connected with the warehouses by two-way bridges. Each pier is double-tracked down its center and is equipped with six elevators. They are separated by slips 250 feet wide, and from the first of the two broadside warehouses by a paved bulkhead 260 feet deep, extending the width of all the piers.

The warehouses are parallel to the shore, each 980 feet long. That nearest the water is 200 feet wide; the other, directly behind it and connected by two-way bridges and tunnels, 306 feet wide with a court in the center. In addition to these buildings there is a boiler house at the northern end of the bulkhead and a large office building, fronting at the foot of Fifty-eighth street.

The terminal has trackage for 1,080 cars aside from through tracks to be kept clear connecting with the Long Island Railroad and the Bush Terminal Railway. In the rearmost, or warehouse *B*, facilities for 50 freight cars in the courtyard are provided. This building has 1,800 feet of vehicle platform space, 900 feet incoming and 900 feet outgoing. The other, or warehouse *A*, has 1,100 feet of vehicle platform space, the combined capacity of both sets of platforms being 290 vehicles loading and unloading at a time.

In addition to six 5-ton elevators, each pier has a locomotive crane of 20 tons capacity, which is given ample room in which to maneuver by the 30-foot headroom allowed on the main floor. Each, furthermore, has a 2-ton traveling crane running the full length.

Warehouse *A* has thirty 5-ton elevators, 10 by 18 feet each, arranged in three groups, each of which is operated by distant control by a single operator, guided by electric signals.

Warehouse *B* has forty-two of the same size of elevators, similarly controlled by three operators, each of whom runs fourteen by means of push buttons. In the courtyard of warehouse *B* are four high-speed electric traveling cranes, by which freight may be raised from the cars on the tracks below to landings or balconies on each of the seven upper stories. Whip hoists may also be used in this court.

Each of the six bridges and three tunnels connecting the two warehouses with the three main piers has two separate passages, each capable of accommodating the largest type of interior electric tractor. Interior transportation equipment comprises:

25 Automatic electric industrial trucks;
47 Mercury four-wheel electric industrial tractors;
1,000 Lansing industrial trailers, four-wheel, designed especially for use with Mercury tractors and capable of tracking exactly in any length of train which the tractor is capable of handling;
5,000 feet of roller gravity conveyor sections for car and truck unloading and loading.

For yard use and work between the Army base warehouses and those of the Bush Terminal adjoining:

17 Walker 5-ton electric trucks;
23 Walker towing tractors;
4 Walker 2-ton crane tractors;
150 heavy four-wheeled yard tractors having platforms 42 inches by 14 feet, with low wheels, platform 14 inches from the ground;
5 railroad switch engines;
2 gasoline (petrol) truck cranes, 5-ton.

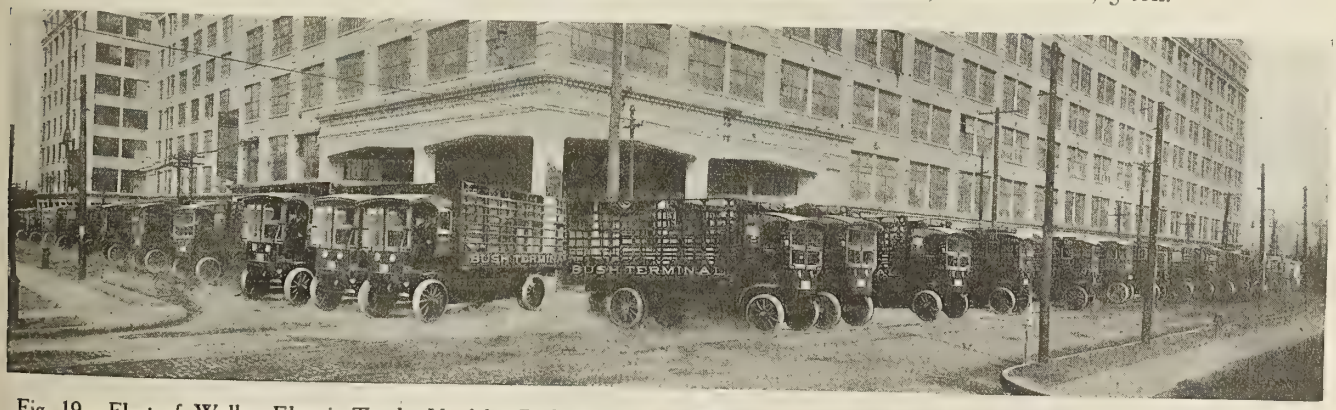


Fig. 19.—Fleet of Walker Electric Trucks Used by Bush Terminal, in Front of the Newest Bush Loft Building—the Largest Reinforced Concrete Building in the World. These Trucks Are Used for Local Delivery, Pick-Ups and Transfers

For transportation between the Army base and other terminals in the port, such as the 2-mile trip to the other end of Bush Terminal, the 7-mile haul to the Hoboken piers of the Army Transport Service and to Governor's Island:

40 Liberty, or Class B, 3-ton Army trucks;
1 Riker 4-ton truck;
1 Mack 5½-ton wrecker.

In the basement of warehouse *A* are gasoline (petrol) and electric garages, the former capable of storing 100 heavy trucks and having two tanks of 11,000 gallons of gasoline (petrol) each. The electric garage has a complete electric charging equipment, arranged with wall plugs to boost the batteries during idle periods, and a large reserve battery room.

With this equipment and the 4,000,000 square feet of floor space afforded by the warehouses, the terminal has



Fig. 20.—Mercury Industrial Tractors in Use by Pennsylvania Railroad at New York Terminal. This Type of Tractor Is Used for the Interior Trucking at the Army Base Terminal. It Is Able to Handle Trains Upwards of Eighteen or Twenty Cars Long, Each Trailer Tracking Exactly with the Tractor Through Tortuous Turns, Due to Castor Front Wheels on the Trailers and a Special Draft Connection

turned over 4,000 carloads of freight in a month, with an inadequate force of soldier laborers. The method of handling the freight is some indication of the systems that must be used in future if America is not to fall behind in international trade.

On arrival at the terminal, a ship is moored to a pier the lower deck of which has been cleared, the upper deck containing perhaps an outbound cargo. The ship is unloaded onto this clear lower deck, the freight being moved away from the edge as fast as it is swung overside by the ship's cranes or cargo masts on the pier. Here the cargo is classified, inspected, etc., and then moved off the pier by one of several means, depending upon its class and destination.

Carload stuff for immediate shipment is loaded directly into the freight cars spotted on the central railroad tracks down the center of the pier shed. As fast as these cars are loaded they are pulled out and placed on sidings ready to be made up into trains for movement the same evening, perhaps. These may be run directly over the Long Island Railroad lines or onto car floats for transfer to railroad terminals about the port.

Less-carload freight and articles for immediate local delivery may be loaded directly into waiting motor trucks and delivered to destination or to railroad freight terminals or transfer stations.

Freight to be lightered to other ships or other waterfront warehouses may be moved directly across the pier to lighters waiting on the other side.

Matter for transfer to Bush Terminal warehouses may be loaded directly into trailers for electric tractors, or into gasoline (petrol) trucks.

Matter for immediate rail shipment to various points in through cars of mixed freight, such cars being loaded on other piers or in or about the warehouses, is loaded onto trailers and hauled by the electric tractors to the cars.

The rest of the cargo, which is to be stored or held in the warehouse for later distribution, is raised to the upper floor by the elevators after being loaded on the industrial trailers, which are there made up into trains and hauled into the warehouses by the industrial tractors.

Warehouse Elevator Service

Freight of various classes is stored on different floors of the warehouses. The tractors pull their trailers to the elevators on the main floor of one or the other warehouse, passing over the bridges or through the tunnels between the two to reach warehouse *B*. Arriving at the elevators, the tractor uncouples its train, or such part of it as is destined for that elevator group, picks up any trailer waiting for transfer to other shafts and proceeds, eventually securing a return train for the pier, when possible. The elevator crew loads the trailers onto designated elevators which are destined in advance for the proper floor, and on closing the door the elevator operator is notified by an electric light signal and moves the elevator.

Arrived at the upper floor, the trailers are taken from the elevator and made up into trains by the elevator crew for that floor. A tractor operating on that floor picks up the completed train and hauls it to the proper department, where it is unloaded by a special crew, the trailers being loaded again with other goods destined elsewhere.

By this means the cargo is kept moving away from the ship's side as fast as it is unloaded. Every article of freight moves directly and continuously to its destination and with the minimum number of loading and unloading operations. The rolling stock is kept employed continuously and empty trips are cut to the minimum. The tractors keep moving constantly and practically never have to wait for trains to haul. The elevators are loaded and unloaded quickly and without rehandling of the goods.

Goods Scientifically Segregated in the Warehouse

The goods in the warehouse are segregated scientifically and the office knows at all times where every article is located. When requisitioned for shipment, a crew is sent to load it on empty trailers.

If it is to go to a pier for a cargo being made up, the process just described is reversed to the point where the goods reach the upper floor of the pier, where they are held pending arrival of the ship.

If for carload shipment, the trailers are hauled either to an outside car door or to the inner court of warehouse *B* for loading, the loading operation being facilitated by the gravity roller conveyors.

If for l.c.l. shipment in through cars being made up of mixed loads at the terminal, it will be hauled to the car door by the tractors if possible, or, if not, transferred to a large trailer or gasoline (petrol) truck at one of the platforms. The latter method would be used for transfers to the Bush Terminal.

If for local delivery in the Metropolitan district, the trailers would be hauled to one of the outbound loading platforms of the warehouse and loaded onto a gasoline (petrol) truck, which would make direct store-door delivery.

Inbound land freight, either for the warehouse or for direct marine shipment, would follow the same lines as

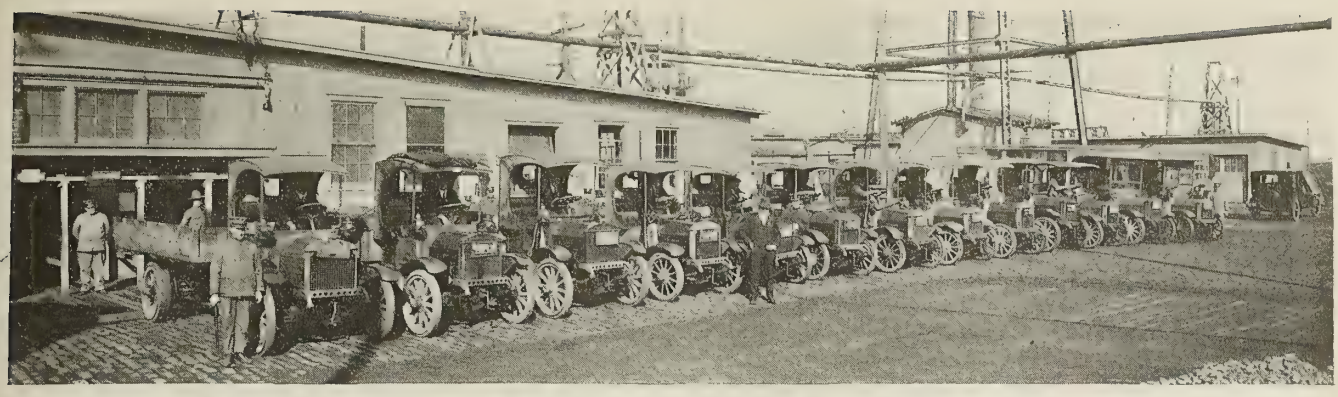


Fig. 21.—Fleet of Federal Trucks Operated by the Submarine Boat Corporation, Port Newark, N. J.

above in a reversed direction, save that different vehicle platforms are provided for outbound and inbound shipments.

Returning to the ship, which we left unloading: In the event that it is to take on another cargo and leave immediately after being loaded, loading could commence as soon as the last sling of inbound cargo had been deposited on the pier, the outbound goods coming down the pier elevators from the upper floors where the outbound cargo is assembled; or, the outbound cargo on the upper floor could be loaded into an outbound ship on one side of the pier while an inbound cargo was being taken from the ship on the other side.

Loading an Outbound Cargo

In a pinch, assuming all of the piers to be occupied with outbound cargo and an extra cargo to be made up for a waiting ship bound for a different destination from that intended for the made-up cargoes, matter in the warehouse could be moved to the pierhead by means of the efficient interior mechanical transportation equipment at even greater speed than it can be loaded into the usual type of ocean freighter.

Further improvement of these methods is possible, of course, nor is it claimed that the entire scheme above outlined is always followed at the Army's terminal, but the above represents what is possible with facilities which have now existed in the port of New York for more than a year.

For example, the Lansing trailers might be replaced with a transveyor or lift truck type which would handle false platforms upon which the loads would be piled when first unloaded from the ship, car or vehicle, and upon which they would remain until loaded into an outbound carrier. Or they might as well be halves or thirds of sectional demountable truck bodies which, while equally useful as indoor trailers, would also be truck bodies and would save rehandling on the loading platforms. The two suggestions might even be combined, the demountable truck body sections replacing the false platforms and being moved about either by lift trucks or by overhead electric telphers.

Railroad car elevators might be installed in such warehouses by which entire carloads could be spotted right on the upper warehouse floor where the goods were to be stored and carloads could be loaded directly from the warehouse section into the car.

The connecting bridges between piers and warehouses might be supplemented by tunnels running into basements of the piers and warehouses, so that inbound matter would



Fig. 22.—Electric Crane Tractors a Convenience in Handling Bulky, Unwieldy Goods, by Which It May Be Loaded Directly Into Freight Cars, Onto Motor Trucks or Direct to the Ship's Sling

be transferred from the main deck of the pier to the waiting warehouse trailers by gravity chutes instead of elevators. The incoming industrial trains would then pass through the tunnels and the outbound over the bridges, gravity escalators transferring the tractors and trailers from the second floor to the basement. Gravity chutes from the second floor could deliver outbound cargoes to the pier edge. Gravity is cheaper and faster than any arrangement of elevators.

Greater efficiency of elevators in the warehouse might be obtained if gravity chutes were used for a large proportion of the downward movement of freight from the upper floors and the elevators were equipped with an automatic return control, so that when the door of an upper floor is opened and closed again the car will automatically return to the main floor.

Instead of trundling the freight to exterior loading platforms for transfer to street vehicles, there might be advantages in having elevators to raise the vehicles to the different floors for direct loading and unloading.

No better indication of the great possibilities that lie in motor transportation at marine freight terminals can be found than in the cases where, even under the miserable conditions now prevailing, motor trucks owned by terminal-operating companies have proved successful.

> "Making marine freight terminals efficient is less a matter of architecture than of method. Present designs of piers in American ports are necessarily based upon present methods of freight transfer. Excepting the more flimsy wooden structures, most of the permanent piers constructed in recent times have the virtue of size and so can be adapted in some measure to more efficient systems of freight movement. Undoubtedly with a change of system, marine terminals to be constructed later on will be designed to harmonize more perfectly with the modern methods."—Merrill C. Horine.

Motor Transportation at the Bush Terminal

Best known among these is the Bush Terminal Company, South Brooklyn, N. Y. About 15 percent of the freight passing over Bush bulkheads is transported by motor trucks. Of course this percentage is low, compared with what may be expected at general terminals, because so much of the Bush business concerns tenants on the Bush properties. The Bush organization employs an extensive fleet of electric and gasoline (petrol) trucks, the electrics predominating for city deliveries. The Bush company uses its vehicles for direct or store-door delivery of freight in a radius of 35 miles. This service is not confined to l.c.l. shipments, furthermore; but where quick delivery of larger shipments is demanded, the trucks are the only satisfactory means of rendering it.

The Wilmington Steamboat Company, operating the Wilson Line steamers between Philadelphia and Wilmington, Del., at one time encountered lively competition from the numerous inter-city motor express lines between its terminals. It wisely chose to fight trucks with trucks and installed store-door delivery and receipt of shipments at the Wilmington end. While no such service was rendered at the Philadelphia end, none was needed because the motor express companies themselves required that goods be brought to their central collecting stations in that city.

Five Packard gasoline (petrol) trucks of from 3 to 6 tons capacity, one Kelly-Springfield of 3½ tons, a 1-ton Ford and five 2½-ton electric trucks were installed successfully. A definite charge for the trucking service on a 100-pound schedule was made and most shippers found it more economical to pay this than to attempt their own trucking under the usual partial-load conditions.

One of the principal reasons for the mushroom growth of inter-city motor express lines and their signal success in many instances is that the long terminal delays are eliminated and the demand for store-door delivery and receipt is met. Consignors are willing to pay a higher rate for quicker time in transmit. The Wilson Line was able to give almost equal service in point of speed at very much lower rates than the motor truck operators could quote. The fact that the Wilson Line trucks have almost a monopoly of freight handling to and from its ships is eloquent testimony of the economy of terminal-operated trucks over privately owned ones, even under present conditions.

The American Dock Company, operating two terminals on Staten Island, New York harbor, has experimented to a certain extent with the operation of its own trucks. The result of this experience has been that, while owing to customs now prevalent this operation has not been highly successful, or worth while extending, it has demonstrated the possibilities of motor truck use where controlled by the terminal company.

From the showing made by the six trucks and three trailers used so far, it has been learned that 300 trucks controlled by the terminal, could be kept busy at the American Dock and Pouch terminals operated by this concern, and could take over all the vehicular transportation work required by the traffic. It is declared that if shippers could be induced to turn over all of this work to the American Dock Company, these 300 trucks could give better and cheaper service than the shippers' own or contracted vehicles.

This is because less clerical work, with its attendant delays and expense, would be necessary than at present. The trucks would be garaged at the terminals, where the work originates and much waste mileage would be saved, owing to the fact that return loads would be the rule rather than the exception that they now are.

These conclusions are based on the assumption that the trucks would be used for local delivery and collection of freight, trans-shipping of l.c.l. freight between American terminals and others at the port, for store-door delivery and receipt of freight from and to the warehouses and for the elimination of free lighterage. By the latter is meant that with efficiently operated motor transportation small shipments could be transferred between steamship and railroad terminals more expeditiously and more economically even than possible at present.

A possible extension of this service would involve longer than local hauls, shipments from and to points as far distant as Albany, N. Y., Philadelphia, Bridgeport and intermediate points being transferred by motor direct from the shipper's door to the steamship side in days where weeks are now involved. Privately owned trucks now carry a considerable traffic of this nature, sometimes by contract with regular inter-city motor express lines and sometimes in the vehicles of manufacturers and wholesalers themselves.

A project of this sort cannot be carried out under present conditions because no preference can be given motor trucks over horse vehicles; no regulation of load, such as would bring about full loads on a relatively few vehicles rather than partial loads on many, is possible; and because of present ferry delays, due to the excessive amount of

traffic of horse vehicles occasioned by the low load factor and slow speed.

So obstructive are present conditions to progress that the American Dock Company has not even been able to displace horse wagons in its own service, finding that traffic conditions eliminate any advantage motor trucks might possess in any but the longer hauls. The equipment now operated comprises three 5½-ton Mack trucks, three 1-ton Fords and eight two-horse wagons. Four more trucks could handle all of the work done by the wagons, if conditions permitted it.

The American Dock Company's estimate on the number of vehicles required to handle all of the trucking is conservative, since trucks on each pier and to all warehouses connect directly with all railroads via a railroad bridge over Kill Van Kull to the New Jersey mainland. Terminals situated less fortunately for railroad connections would undoubtedly find a greater proportionate volume of motor transportation necessary.

In an effort to do the work of the American Dock horse vehicles economically with the Mack trucks, trailers have been tried. By their use it was hoped that a sufficiently large load per trip could be made to offset the decrease in average speed occasioned by traffic and slow ferriage. To pay, a truck must make a minimum of two trips per day, one trip being sufficient for the horse wagons. In the work which is done by the horse wagons, a motor truck is unable to make more than one trip per day. Troy 2½- and 3½-ton trailers were used, therefore, in an effort to make 1½ to two-horse wagon loads per motor truck trip, since the truck with a trailer is able to proceed through traffic about as fast as alone. Owing to difficulties with ferries and some of the docks which prohibit the use of trailers, this has not been entirely successful.

There is no doubt that the type of ferry boats in use in New York militate considerably against efficient motor truck use in terminal haulage. As most of them are today constructed, there is a double driveway down the center of the main deck, with passenger cabins at the side, most of them having no accommodations on the upper deck. Those which have passenger cabins on the upper deck still retain those on the lower deck, though the upper cabins are always adequate for the crowds. The result of this restricted vehicle accommodation is that during rush hours it is sometimes necessary for trucks to wait in line from 1½ to 3½ hours before getting on a boat.

One of the East River ferries has four driveways on each boat, the passenger cabins on the lower deck having been eliminated. The passengers occupy the upper deck exclusively and leave and board the boat by upper gangplanks. They are thus out of the way of vehicular traffic and the capacity for vehicles is doubled.

There is no royal road to terminal efficiency, else it would have been traveled long since. But there is a key to the situation, and that is motor trucks. Big tonnage on the water, big tonnage on the railroads, high speed at both places—these things spell economy because they save time and labor. To realize their advantages to the full, they must be linked up by road vehicles of big tonnage and high speed, as compared with the horse vehicles making their last stand at city terminals today.

Shipping Policy.—The executive committee of the National Merchant Marine Association has adopted and submitted to the members of the council for action the following recommendations:

That so many of the steel vessels of desirable commercial types now owned by the Government as are not needed for the immediate development of new trade routes should be sold for operation under the American flag to American individuals, or to firms, corporations or associations a majority of whose stock is owned by American citizens.

That vessels of other types be sold as rapidly as possible, without restriction as to flag or purchaser, but giving preference, on equal terms, to American purchasers.

That pending their disposition by sale, Government vessels should, as far as possible, be chartered upon a basis favorable to successful operation, to American individuals, firms, corporations or associations, and that the lessees be given options to purchase said vessels within a reasonable time.

That until sold or chartered, Government-owned vessels should be operated by the Government.

Crude-Oil Motors vs. Steam Engines in Marine Practice*

BY J. W. MORTON

THE number of articles which have appeared of late describing the performances of the so-called motorships would seem to indicate that for marine purposes the crude oil motor is rapidly replacing the steam engine. The chief reason for this is not to be found, as might be expected, in the lower operating cost of the crude oil motor, but is rather due to other factors which, when considered, lead to the conclusion that the crude oil motor is probably the most economical prime mover of today.

Perhaps the correctness of this statement can best be shown by comparing a steamship with a motorship. In the case of a war vessel, for instance, there are eight factors which ought to be considered in choosing the form of motive power, namely, weight, space occupied, radius of operation, preparedness, crew necessary, fuel, auxiliary equipment, and cost.

The weight of the power plant is of great importance, for a saving therein can be utilized to increase the armor of the ship. If, for example, a warship of 3,500 tons displacement be equipped with crude oil motors, there will result a saving as indicated by Table 1, which is based on a single steam engine developing 4,400 horsepower and three units, of 1,600 horsepower each, of a standard make of crude oil motor.

In the case cited, about the same space would be required for both motor plant and steam plant, but the total horsepower could just as well be developed by two units of slightly larger size, and if this were done approximately one-third the space would be saved. Moreover, if oil motors were used, the space occupied by the coal bunkers could be partially released, as crude oil can be stored in tanks under the engine floor and below the protective line.

It is obvious that a warship must possess a great cruising radius, and if weight for weight of engines be con-

TABLE 1.—COMPARATIVE WEIGHTS OF POWER PLANTS IN STEAMSHIPS AND MOTORSHIPS

	Steamship		Motorship		Savings in Motorship	
					Weight, Tons	Percent
Engine, tons	335		264		71	...
Percent of displacement		9.6		7.5	...	2.1
Fuel, tons	246		86		160	...
Percent of displacement		7.0		2.5	...	4.5
Crew, provisions, water, tons	91		82		9	...
Percent of displacement		2.6		2.3	...	0.3
Totals	672		432		240	6.9

* From a paper read at the spring meeting, Detroit, June, 1919, of the American Society of Mechanical Engineers.

sidered, then the ratio R of the cruising radii of a steamship and a motorship may be expressed by the formula

$$R = \frac{V_c \times H_o \times W_c}{V_o \times H_c \times W_o},$$

where

V_c = cubic feet occupied per ton of coal = 45.
V_o = cubic feet occupied per ton of oil = 35.
H_c = British thermal units per pound of coal = 14,000.
H_o = British thermal units per pound of oil = 18,500.
W_c = pounds coal consumed per effective horsepower-hour.
W_o = pounds fuel oil consumed per effective horsepower-hour.

In the case of the warship under consideration, if W_c be taken as 1.75 and W_o as 0.4, then the ratio will be

$$R = \frac{45 \times 18{,}500 \times 1.75}{35 \times 14{,}000 \times 0.4} = 5.7.$$

The cruising radius will, of course, vary with the type of engine and ship, but, nevertheless, the average ratio, as

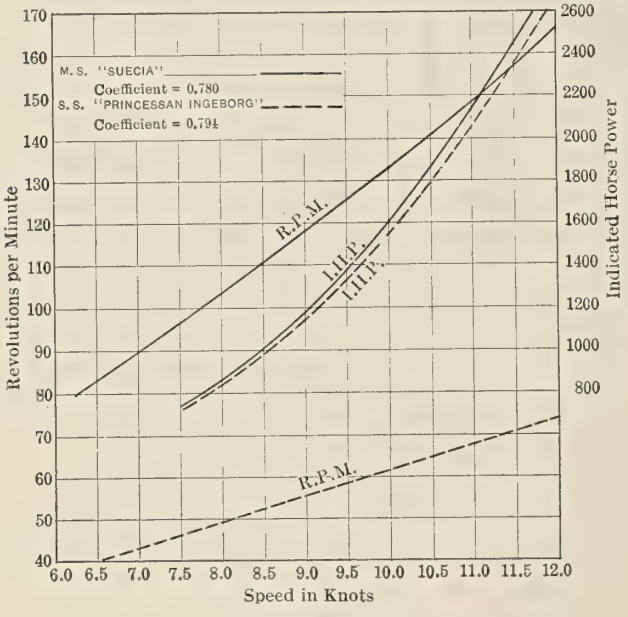


Fig. 1

expressed above, may be taken at least as 1 to 5 in favor of the crude oil motors.

A motorship, in sharp contrast to the steamship, is always ready for action, as no time is lost in getting up steam. Moreover, fuel is consumed only when the motors are running, and the motorship is capable of maintaining full speed as long as there is a supply of fuel.

As there is no need for stokers on a motorship, the crew can be decreased about 10 percent, and this, of course, permits of a corresponding saving in provision, water storage and quarters.

In the case of a steam-driven warship, the smoke from the stack frequently betrays the location of the ship, for it is well known that a vessel can be easily located by its smoke long before the masts or hulls are in sight. Another drawback to the steam-driven warship lies in the fact that the smoke covers the ship with a film of soot which, getting into vital parts of auxiliary machinery, necessitates frequent cleaning and unnecessary wear and tear. On the other hand, when oil is used there is no smoke, the handling of the oil is both cleaner and easier, and the life of machinery and equipment is greatly increased.

When a change is made from steam to oil the auxiliary machinery is usually electrically driven, as this has been found to be most satisfactory. The dynamos are usually driven by separate oil motors. Hot water for heating and sanitary purposes is obtained from a small oil-fired boiler, and, while the first costs of such installations are high, they are in time offset by the lower operating costs.

Prior to the war the first cost of a crude oil motor plant was approximately twice that of a steam plant. This was partly offset, however, by the savings in operating expenses, under which item comes cost of fuel, labor and supplies. The cost of fuel naturally depends upon the prevailing market for coal and oil. In regard to maintenance, there is practically no information available, as the crude oil motor is still in its infancy so far as this country is concerned.

Cargo Ships

Many of the preceding statements concerning the installations of crude oil motors on battleships can also be properly applied to cargo ships. During the last four years a number of such vessels have been equipped with crude oil motors of both the two-stroke and four-stroke cycle type, and, while engineers are not agreed as to the best type, the four-stroke cycle is to be preferred.

One of the most successful installations of this kind is that on the motorship *Suecia*. This ship has a length of 362 feet, a beam of 51 feet 3 inches, a depth of 25 feet 6 inches, and a capacity of 6,550 deadweight tons. It is provided with twin screws driven by two 1,000-horsepower Diesel engines of the 8-cylinder 4-cycle type, and also with two auxiliary engines of 200 horsepower each. The vessel was built for service between Sweden and La Plata and its first run was a test made on December 4, 1913. The curves in Fig. 1 give some idea of the characteristics of the motors. The dotted curves are given for the sake of a comparison with the steamship *Princessan Ingeborg*, built two years before the *Suecia* and for the same company. The *Princessan Ingeborg* has a length of 300 feet, a beam of 48 feet 9 inches, a depth of 22 feet 4 inches, and a capacity of 5,890 deadweight tons. The block coefficient for the *Suecia* is 0.78 and for the *Princessan Ingeborg* 0.794, and thus both vessels are about equal in size and excellence. A comparison will show that the same amount of power is necessary to obtain equal speeds when the displacements are equal. This would seem to indicate that there is no difference between transmitting power through two small comparatively fast-running screws as is done on the motorship, and transmitting power through a single slow-running screw as in the case of the steamship. The propeller on the steamship has a diameter of 17 feet, while those of the motorship are only 10 feet. The ratio of indicated to effective horsepower is therefore the same for both ships, and the total efficiency of engines and propellers is also about the same.

In order to correspond to the motorship in horsepower, the steamship would be obliged to carry an extra boiler. This would increase its weight 570 tons, whereas the weight of the machinery on the motorship is only 470 tons. The length of the engine room of the motorship is 41 feet, while the length of the engine room and necessary boilers in the steamship is 66 feet, and this despite the fact that the steamship has less horsepower.

Motor Sizes

The fuel consumption during the trial trip of the *Suecia* was 0.2948 pound per indicated horsepower, or 0.3685 pound taking the mechanical efficiency at 80 percent, a very satisfactory value.

The horsepower of a crude oil motor, whether of the

constant volume or constant pressure type, is somewhat limited by practical considerations of construction. At the present time the maximum size is 2,500 horsepower per shaft and from six to eight cylinders for the two- and four-stroke cycle constant pressure type, although some experimental engines have been built as large as 6,000 horsepower. This is in sharp contrast, however, to the power developed by steam, which runs as high as 15,000 horsepower for the steam engine and 35,000 horsepower for the steam turbine.

Crude oil motors of small horsepower are usually of the high-pressure type, medium, so-called semi-Diesel or hot-bulb type and two-cycle constant volume type. Prominent among such semi-Diesel engines are the Bolinder, Scandia, Avance, Alliance, Tuxham, Gidion and Holm.

It has been proved both by experiment and practice that the constant volume, high-power, single-cylinder type of motor is unsatisfactory, and chiefly because of the fact that the enormous heat generated at the pistons during the explosion must travel a great distance before it is transferred to the water jacket, and as a result the central part of the piston is heated to such an extent that pre-ignition frequently occurs. Furthermore, the sudden rise in pressure sets up detrimental vibrating stresses in the material, and it is also exceedingly difficult to obtain a proper mixture of air and oil, rapid ignition and complete combustion and exhaust.

On the other hand, the constant pressure oil motors of high power must have numerous cylinders all of the same size, and the high pressure, which lasts approximately 10 percent of the stroke, necessitates a careful design of the crank mechanism. This applies especially to the crank-shaft, which is both difficult and costly to produce. Moreover, in motors with only a few cylinders, the flywheel must be heavy, large and expensive if a great variation in speed is to be cared for. Difficulties have also been encountered in keeping the piston leak-proof; if it fits too tightly the result is a large frictional loss, and if the clearance is too great there will be a loss of pressure. The greater the piston area, the more effective must be the cooling system, as the surface exposed per pound of working medium decreases as the cylinder dimensions increase. This accounts for the lower thermal efficiency and the horsepower available per unit of piston surface with large cylinders.

The Design of Shackles and Long Chain Links

BY ARTHUR RAYMOND

That a chain is only as strong as its weakest link is an adage as well known to the lay-mind as to the technical one. Shackles, special long links, swivels, etc., are as much a part of a chain as the many standard size links that make up the most of the chain itself. Ordinarily, a designer experiences no difficulty in determining the proper size chain (made up of links, shackles, etc.) to use for a given working load, as there are ample tables, curves, etc., compiled by commercial concerns in their publications and similar data found in handbooks to cover a large range of working stresses. However, the writer recently had quite a little designing on shackles and long chain links to take care of heavy loads beyond the upper limit of those usually tabulated as mentioned above.

The formulae that were available gave results that obviously were much too large, and if used would have given an uneconomical use of material and money, and, besides, would reflect badly upon the reputation of the engineer.

After exhausting the formulae in text books without attaining the desired end, letters of inquiries were sent to a number of professors and other capable men, but their replies were unsatisfactory in that they either treated the subject only for the fundamental principles involved or else duplicated some of the information that was already at hand.

In the meantime the writer deduced empirical formulae for the design of shackles and long links based on breaking tests. These formulae apply not alone for special cases, but also within the limits of the tables on shackles, links, etc., found in hand books.

Shackles

For straight-jaw shackles the formula is:

$$d = \sqrt[3]{.00008503Pl},$$

where

d = diameter of wire in inches.
P = safe load on shackle in pounds.
l = span in inches.

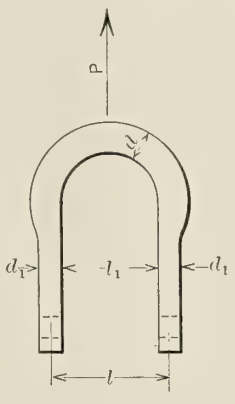


Fig. 1

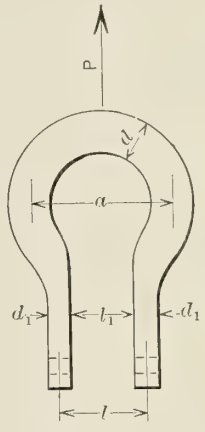


Fig. 2

This formula is based on a working stress of 10,000 pounds per square inch (factor of safety 6).

For bow shackles increase d found by above formula by 10 percent.

In proportioning the shackle (see Fig. 2), a should never be greater than $2l$, and preferably less than $2l$. d is obtained by designing each prong to take $\frac{P}{2}$ in tension and adding 25 percent to take care of any eccentricity of loading.

In designing the pin, the best results are obtained by proportioning it to a bending moment equal to $\frac{Pl}{6}$.

Long Links

The formula for long links is very simple and gives good results:

$$A = \frac{P}{1.25 \times S},$$

where

A = area of wire in square inches.
P = safe load on link in pounds.
S = working stress in pounds per square inch (tensile).

The use of these formulae proved quite satisfactory, and they are given to the readers of this technical publication who may have experienced similar difficulties.

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The Naval Architects' Meeting

DURING the war the annual meetings of the Society of Naval Architects and Marine Engineers were necessarily handicapped on account of the small amount of time which many of the members engaged in war work could give to the work of the society. In spite of this, much information that was of value and importance was brought out at the meetings and the increase in membership and attendance was highly gratifying. Now that the imperative demands of war work have ceased there is an opportunity to make the forthcoming annual meeting of the society, which will be held in New York on November 13 and 14, a memorable occasion. Sufficient time has elapsed so that the gigantic deeds of shipbuilding and shipping accomplished in the short space of two years can be reviewed in their true perpective and valuable lessons learned from an analysis of these strenuous efforts. The programme of the technical meetings, we are assured, will include some of the most important papers ever presented before the society, and an opportunity will be given for excursions to the large shipyards and marine establishments in the vicinity of New York where the tangible results of the two-year period of war activity can be investigated at first hand.

As Others See Us

OUR attention has been called to the following item published in the September issue of our British contemporary *The Steamship:*

"The main trouble with American shipyards is that their managers failed to rise to the opportunity to advertise themselves to the world at a time when they were flush with orders and making profits. They failed to invest money to create a goodwill, such as that possessed by foreign establishments, which kept their advertisements going in the technical journals when their works were being operated by the Government and no one could prophesy when the plants would again be available for commercial use. This shortsightedness is in evidence in practically all of the leading lines of American industry, and, with few exceptions, which could be counted on the fingers of one hand, the best American shipbuilding and engineering firms are almost unknown quantities abroad, which are nowhere surpassed and in but few instances equaled."

The reading of this item perhaps will do no harm to the faint-hearted new-comers in the American shipbuilding industry, who, during the months of plenty, have hesitated to advertise their facilities for fear that they would get work which at the instaant they could not handle, and who have paid no attention to the fact that war work would soon be over. As a further hint to the faint-hearted, it may be mentioned that the first contract placed in an American yard by a neutral nation after the armistice was signed went to a shipbuilding company which has consistently advertised its facilities in the marine press before, during and after the war. Who will be the next?

The American Seagoing Merchant Fleet

THE seagoing fleet of American merchant ships of over 1,000 gross tons each on August 31, 1919, registered for the foreign trade or enrolled for the coasting trade by sea, as shown by the returns of the Bureau of Navigation, Department of Commerce, comprised 2,245 ships of 8,100,008 gross tons, of which 1,558 of 6,707,820 gross tons were steel steamers, 347 of 840,611 gross tons were wooden steamers, 95 of 180,487 gross tons were steel sailing vessels or schooner barges, and 245 of 371,099 gross tons were wooden sailing vessels or schooner barges. Of the steel steamers, 123 of 1,046,840 gross tons were of 7,000 gross tons each or over, 249 of 1,583,229 gross tons were from 6,000 to 6,999 gross tons each, and 251 of 1,392,926 gross tons were of 5,000 to 5,999 gross tons each. The largest wooden steamers were of less than 4,000 gross tons each.

According to reports issued by the Shipping Board on September 13 the American flag floats from the mastheads of 1,280 oceangoing ships, 1,107 of which were built by the Shipping Board. Up to the outbreak of the war, the United States had only fifteen vessels of 1,000 tons and over engaged in overseas trade. In June, ,1914, according to the same report, the total gross tonnage under the American flag, including coastwise shipping and the fleet operating on the Great Lakes, was 4,287,000 gross tons. In June, 1919, its gross tonnage was 11,983,000, an increase of 278 percent, chiefly in oceangoing ships.

The steam tonnage under the American flag now comprises 24.8 percent of the steam tonnage of the world. In the four years preceding the war the shipyards of this country turned out a total of 107 seagoing vessels of 1,500 tons and over, this construction representing 805,037 deadweight tons. During 1918 there were launched from the yards under the control of the Shipping Board a total of 4,216,656 deadweight tons, five times more than had been built in the four pre-war years. From January 1,

1919, to August 29, 1919, 3,983,135 deadweight tons of shipping have been launched and 3,845,140 deadweight tons delivered, making a total for the twenty months of 8,199,791 tons launched and 6,925,233 delivered.

The original construction programme contemplated the building in this country of 17,807,071 deadweight tons of shipping. Of this total 1,292 ships, with a deadweight tonnage of 7,125,225, have been delivered. There are fitting out in wet basins 408 steamships of 1,920,000 deadweight tons and, on the ways 497 ships of 3,286,105 deadweight tons. Steel steamships numbering 227, of 1,476,610 deadweight tons, are under contract but upon which work has not yet begun. The total contracts canceled called for 886 vessels of 4,515,285 deadweight tons. At the end of August, the total seagoing vessels under control of the Shipping Board numbered 1,280, with a deadweight tonnage of 7,706,400.

Propeller Data from the New Mexico's Trials

IN a paper by Commander S. M. Robinson, U. S. N., fleet engineer of the Pacific fleet, published in the current issue of the *Journal of the Society of Naval Engineers,* some interesting information in regard to propellers and propulsion generally is given that was obtained from the trials of the electrically propelled battleship *New Mexico.* Two sets of trals were held, the first after the ship had been out of dock about seven weeks and the second just after the ship had been docked. It was found that there was a difference between the two trials of about 4,250 shaft horsepower at 21 knots, or an average increase of resistance of about 9.6 percent, due to the foul condition of the ship's bottom. This experience was corroborated in the case of the battleship *Pennsylvania,* and it is pointed out that fouling occurs very rapidly in the first few weeks that a ship is out of dry dock, and that after that the rate of increase of resistance due to fouling falls off very rapidly.

As the *New Mexico* is driven by four screws, trial runs were made with two screws, first the inboard and then the outboard, idle and perfectly free to turn. It was found that the increase of effective horsepower due to the dragging of two screws varied from 36.4 percent at 7 knots to a minimum of about 13 percent at about 12½ knots, and that the percentage was still increasing at 15 knots, which was the highest speed of the ship obtained under these conditions. These results, it is held, should convince anyone of the futility of trying to save fuel by providing a multiplicity of screws and engines and reducing the number in use as the speed of the ship is reduced. The saving due to increase of engine efficiency will be only a very small fraction of what is lost due to the increase in resistance due to the dragging screws. In the case of the *New Mexico,* at 15 knots it required about 2,400 more shaft horsepower with two screws than with four screws, or an increase of 26 percent in horsepower.

In this connection another point was brought out. The data showed that the idle propellers drag at between 60 and 65 percent of the revolutions required to drive the ship at the given speed; at a speed of about 7 knots the screws ceased to revolve. As this percentage seems to be about the same for all types of ships, it offers a very easy method of plotting retardation curves simply by observing the revolutions of the engine from instant to instant and obviates the necessity of obtaining the actual speeds of the ship by bearings. It is noted that when running with two screws the dragging screws run at approximately one-half of the revolutions made by the driving screws.

A further comparison of the performance of the inboard and outboard screws showed that more power was required for the same speed by the inboard screws than by the outboard screws, and paradoxically, the revolutions per minute in the inboard screws were less than that of the outboard. The apparent paradox in regard to the revolutions, Commander Robinson points out, is easy to understand, as there is a small difference in the "slip block coefficient" for inboard and outboard screws, which will, of course, slightly affect the basic speed and slip of the two screws. The difference in horsepower, while not so easy to explain, is due to the fact that the inboard screws cavitate sooner than the outboard. It is pointed out that on a four-screw ship it is possible, when driving with two screws only, to load these very much more heavily before cavitation takes place than can be done when driving with four screws, although the slip of the screw is more than twice as great with the two-screw condition than with the four-screw condition.

What Do You Think?

SINCE the first of the year numerous reports have been circulated in various quarters to the effect that large numbers of American Government-owned ships are laid up in dry dock, both in this country and abroad, for repairs, and that in general American vessels built during the war and now owned by the Government are not giving a good account of themselves in actual service. The chairman of the Shipping Board has not hesitated to deny these reports vigorously, and to express the opinion that such statements are very probably part of a propaganda to depreciate the prices of American vessels now being sold by the Shipping Board. Other Shipping Board officials have pointed out that these reports are calculated to result in setting high rates for insurance on American vessels, which would handicap them in competition with vessels of foreign registry.

According to reports that have reached this office ninety-nine steel ships owned by the Shipping Board are undergoing repairs in the New York harbor. All of these vessels, with the exception of a few former German ships, have been constructed during the war.

Based upon the average conditions of summer service, is such a volume of repair work excessive? If so, why is it necessary? Is it on account of poor workmanship, faulty equipment, "rush conditions," or incompetent operators? What do you think?

Letters from Marine Engineers

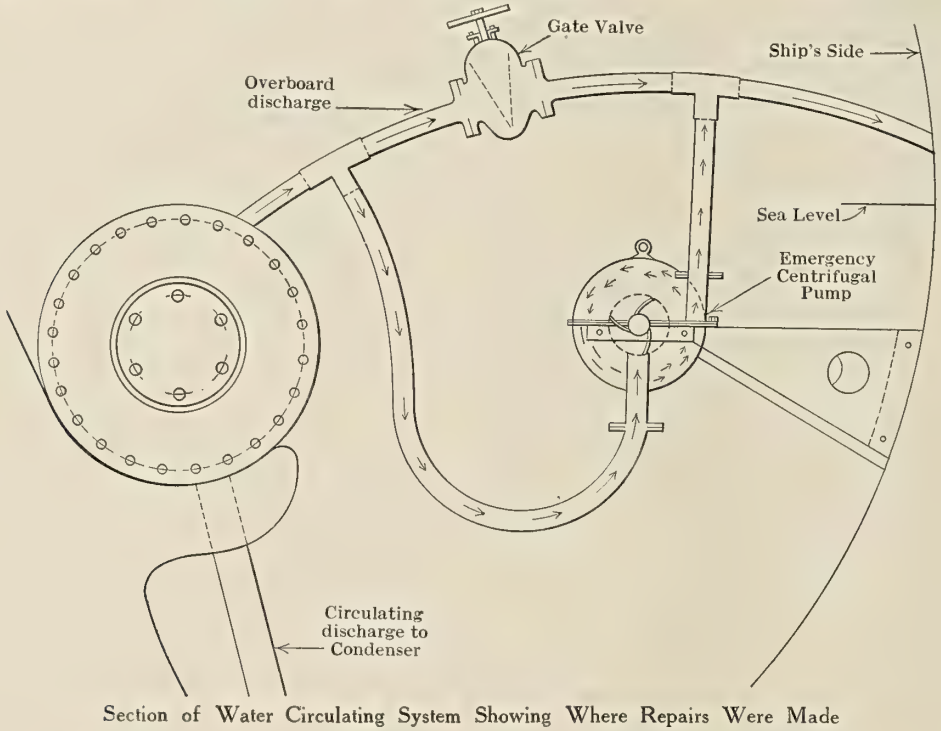
Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Repairing a Water-Circulating System

An interesting and ingenious precaution taken in anticipation of a breakdown in the main circulatng pump of the steamship *Opihi* was brought to the attention of the writer recently. While getting ready in Lyttelton, New Zealand, for a long voyage to Vancouver, a bad crack was found at the base of the circulating pump. By means of the electric welding outfit a fairly good job was made in repairing the crack, but, as the cast iron was rather badly corroded, the chief engineer did not altogether like the idea of placing too much dependence on this repair.

In the yard of the engineering works near the dock he found a second-hand centrifugal pump, which was installed in the following manner: The pump was placed on a platform behind the engines about 18 inches below the sea level. The overboard discharge pipe in the condenser was cut and a gate, or sluice, valve fitted to it. Between the gate valve and the condenser a tee was put on the pipe and the connections from the discharge pipe led to the suction of the centrifugal pump, while the discharge from the latter was led into the main discharge pump through another tee piece on the other side of the gate valve. In the event of the circulating pump chamber giving out on the main engines, it could be kept watertight by means of canvas; then, if the valves were taken out of the pump, the gate valve on the discharge pipe closed and the centrifugal pump started, the condenser would become a suction type. This means that, in spite of the water being forced through the condenser by the circulating pump on the main engines, it would be drawn through by the suction of the centrifugal on one side of the gate valve and discharged on the other. The great advantage of this idea was that, with the main engine stopped, the ship, having no winch condenser, the exhaust from the engines driving the dynamo, pumps, winches, etc., could be led into the main condenser, which would take the place of an auxiliary condenser. The valves would, of course, have to be taken out of the circulating pump on the engines to allow for the uninterrupted flow of sea water to the condenser. By starting up the centrifugal, the main condenser would now become a winch condenser and save exhausting into the atmosphere with the corresponding loss of water.



Section of Water Circulating System Showing Where Repairs Were Made

Luckily, the repair on the circulating pump held out, but it was a great relief to the chief engineer to know that he always had another circulating pump if needed.

Vancouver, B. C. EDMUND B. DELL.

A Comparison of Ship Performances

Seafaring men, shipowners and engineers will no doubt be interested in an account of the performance of the two ships *Opouri* and *Opihi,* which, although entirely different in characteristics, had the same set of engines and boilers installed at different times.

Some years ago the *Opouri* was wrecked outside the port of Lyttelton, New Zealand. Because of the shortage of ships during the war, an enterprising firm bought her with the idea of salvaging the boilers and engines and installing them in another boat.

At low tide a hole was cut in the side of the *Opouri* and

the boilers rolled out of her. By a similar method the engines were recovered. A German barque, the *Opihi,* over forty years old, was then purchased and it was decided to place the salvaged engines and boilers in this old sailing ship. The following data will enable the reader to see at a glance the performance of each vessel:

S. S. Opouri

Length	170 feet
Beam	27 feet
Depth	12 feet
Indicated horsepower	560
Powered with triple-expansion engine, 15 inches by 25½ inches by 41 inches by 2 feet 6 inches stroke.	
Carrying capacity	750 tons
Fuel consumption, per day	13 tons

In smooth coastal waters on a 30-day run, consuming 13 tons of coal a day, the vessel averaged 9.5 knots.

S. S. Opihi

Length	210 feet
Beam	34 feet
Depth	21 feet
Indicated horsepower	560
Powered with the same triple-expansion engine as the *Opouri,* 15 inches by 25½ inches by 41 inches by 2 feet 6 inches stroke.	
Carrying capacity	1,620 tons
Fuel consumption, per day	10 tons

This ship, with twice the carrying capacity, averaged 8.4 knots, with a fuel consumption of 10 tons per day for a 15-day run. On a run of 37½ days from Lyttelton to Vancouver, a distance of 6,920 miles, she consumed 393 tons of coal and averaged nearly 7.7 knots throughout the voyage, in spite of the fact that bad weather was encountered most of the time.

Vancouver, B. C. Edmund B. Dell,
Canadian Pacific Railway,
British Columbia Coast Service.

A New System of Dry Docks

A new dry dock system has been evolved to facilitate the emptying of a dock and to utilize the otherwise waste water in partially filling an adjacent dock. In the operation of dry docks, it is the common practice, after a vessel has been floated into position and properly shored, to pump out the water in order to leave the dock in condition for working purposes. This pumping forms quite a considerable item in the cost of operation, while a relatively long time is wasted in getting started on the actual repair or reconstruction work.

The new system consists of several docks arranged side by side and interconnected by conduits, as shown in Fig. 1.

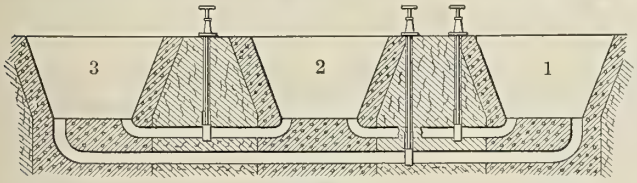


Fig. 1

These ducts serve to transfer water from one chamber to another as required. Each conduit is provided with a gate valve, the stem of which extends upward through the earth or concrete and terminates in an operating lever or wheel. The valve may also be of the solid type, operating in a guide built into the inclosing wall.

With three docks the method of operation is quite simple. After dock No. 1 is full and the ship to be repaired floated into place (*A,* Fig. 2) the valves connecting docks Nos. 1 and 2 are opened and the water flows from one to the other until a common level is reached (*B,* Fig. 2). To further reduce the level in dock No. 1, the valves between 1 and 2 are closed and those between 1 and 3 opened. This time the water reaches a common level in 1 and 3 (*C,* Fig. 3) and leaves but a small amount

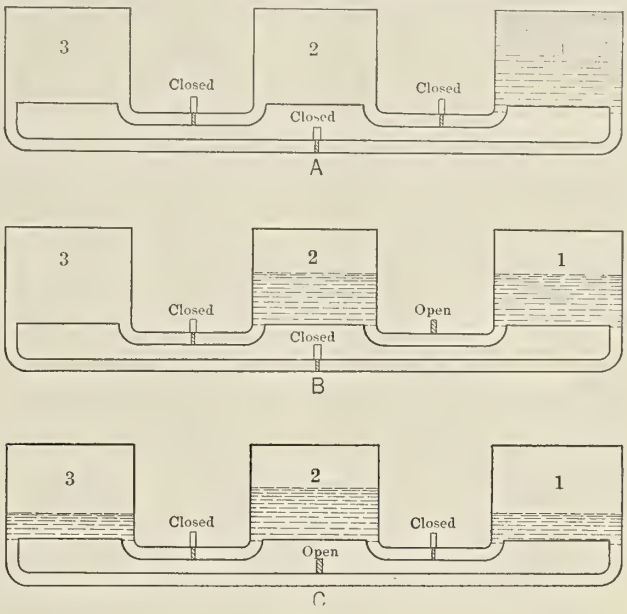


Fig. 2

in dock 1 to be pumped out. With a greater number of connecting docks the pumping necessary is reduced to a very small amount.

It can readily be seen that in a large docking system a considerable number of combinations are possible when the docks are connected. Schedules of repairs may be so arranged that one dock is always flooded and in a receiving condition, while others are simultaneously ready to discharge a vessel or vessels.

Philadelphia, Pa. John Lake.

Pump Signal

I went over to Jerry's plant one afternoon to get his book on boilers. While I was there he was rigging up a pump signal from the pump room to the engine room to tell him at all times whether the pump was operating or not. I considered the scheme pretty nifty and sketched it

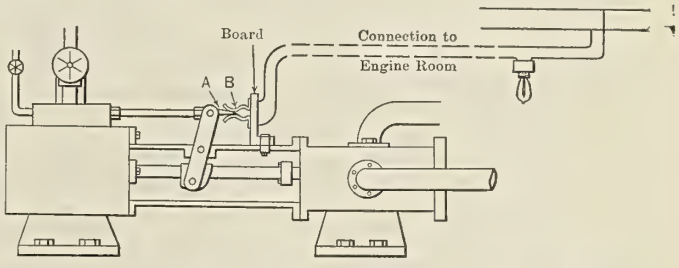


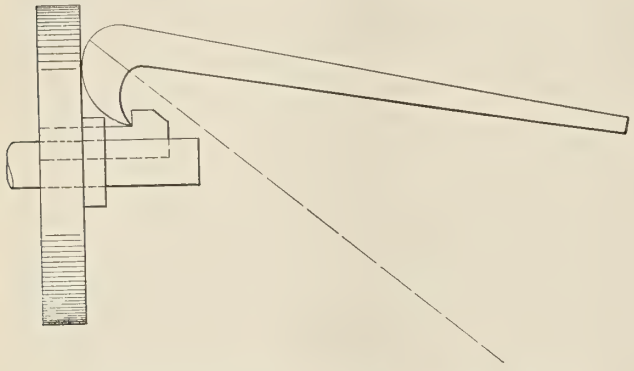
Fig. 1.—Slide Valve Rod Fitted With Taper Steel Wedge

down to pass along. A piece of board was fitted up with a couple of spring prongs or contacts and bolted to the top tie rod near the end of the slide valve rod. The latter was fitted with a taper steel wedge, as shown in Fig. 1. Each time the pump made a double stroke it made a contact with the spring prongs, as shown at *A-B.* A light was wired up to hang over the log desk in the engine room in circuit with this apparatus, so the man on watch could always note the signal working and rest easy about the pump.

Concord, N. H. Chas. H. Willey.

Device for Pulling Keys

A lever that has proved useful in pulling out keys is shown in the accompanying sketch. It was made from a 2-inch by 1-inch steel bar about 24 inches long, tapered at



Lever Made From Steel Bar for Pulling Keys

one end, and with a rather sharp hook at the other. The bar is sufficiently strong so that it may be tapped with a hammer if necessary to start the key.

Worcester, Mass. E. M. Peterson.

The Qualifications of a Marine Engineer

The early days of steam possess an interest all their own. Recently the writer had the privilege of perusing an early volume of a long-extinct periodical called *The Artisan,* for the year 1843.

This was one of the earliest industrial journals, and, although its interests were very wide in range, engineering activity occupied a large space.

The extract given below has lost none of its moral during the passage of 76 years, although it may make quaint reading. It touches upon the prime duty of blowing down due to salt water feed, a practice now almost unknown. The "depositure of scale," as the extract has it, is not lessened by the admission of larger quantities of sea feed, although the pressure carried at that date was insufficient to give the temperature requisite to precipitate sulphates.

The journal was perfectly serious in tone, was representative of the steam practice of its day, and a large part of its interest lies in a series of plates depicting marine and other engines. It may be added that regular steam packet communication with America was not then established, although a number of steam vessels had made the voyage. There is grave discussion in its pages as to whether such service could be made to pay as a commercial venture. The best-recorded coal consumption in its pages is 8 pounds coal per horsepower hour, and as bunkers had to serve for the double passage it was considered that the ship could not carry sufficient coal to be safe, leaving aside consideration of cargo.

London, England. A. L. Haas.

Qualifications of a Steam Boat Engineer

(*The Artisan,* November, 1843.)

It is not book learning that is required in the engineer of a steam vessel, but care, good sense, and self-possession; and in the proportion in which he possesses these qualities is his eligibility to be estimated. For the want of assiduous care no other quality can compensate, but this quality will go for little if there be a want of skill and penetration, or timidity in the hour of danger. A vast number of lives are in the engineer's hand, and such a responsibility should only rest upon one who is prepared to try all things and to dare all things when the occasion is such as to demand his energies.

The attention to the feeding and blowing off of the boilers is the engineer's most important duty. In sea-going vessels, blowing off should be practiced every two hours—that is, twice every watch. It is a mistake to suppose that this frequent blowing off diminishes the pressure of the steam, for, although there is more water to heat in consequence, the difference is more than made up by the greater facility with which sea water yields steam than concentrated brine. Besides, unless the blowing off be frequent, the depositure of scale on the flues so impairs the conducting power of the metal that a large quantity of the heat which would otherwise enter the water escapes up the chimney. There is no more important qualification of a nautical engineer than to be prepared with remedies for all the conceivable disasters likely to happen to steam vessels at sea. Thus, if the vessel were to spring a leak, the obvious resource would be to open the injection from the bilge; but suppose that both injection hoses were to become choked with coal dust within the condenser, as we have known under such circumstances to happen, what would be resorted to then? In such a case the injection should be admitted through the snifting valves, supposing the water high enough to reach them, the condensation being thereby accomplished in the air pump instead of the condenser. Again, suppose the eccentric catches were to give way—a thing by no means infrequent—it is pleasant beforehand to know that the proper motion will be given to the slide by the lever of the opposite engine, or by the cross-tail butt, or connecting rod of the same engine; and every engineer should settle in his own mind, after a survey of the engine with which he has to deal, what expedient he would adopt in such an emergency.

Plugs for Leaky Condenser Tubes

The customary practice of placing wooden plugs in leaking condenser tubes reduces the condensing surface and obstructs the passages. One means of overcoming the difficulty is to make plugs from a 1-inch hexagonal brass bar, as shown in Fig. 1.

The length of the plug illustrated is approximately correct. The diameter would have to be varied to fit the tube to be repaired, so that the latter might be made absolutely tight. The section *A* has 28 threads per inch.

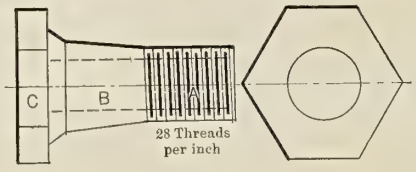


Fig. 1

Section *B* is tapered 1/32 inch per inch, while *C* is a ¼-inch fillet on the top of the plug. A ⅜-inch or larger

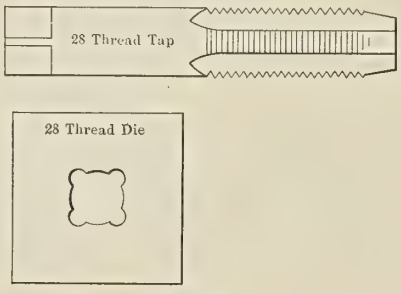


Fig. 2

hole is drilled through the plug to prevent obstructing the tube. Fig. 2 shows a special tap and die to be used in cutting out the plugs.

Stillwater, Minn. Otto Dorthen.

Hog Island Shipyard.—It has been announced that the Hog Island Shipyard will be sold by the Government to the American International Corporation and that it will be converted into a great transatlantic terminal, similar to the Bush terminal in New York.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Appendage Resistance

Q. (1022).—Having the model basin results of the resistance of a model, with a certain appendage on it, at speeds corresponding to speeds of from 6 to 16 knots of the ship, we made a run with the appendage off at a speed corresponding to 11 knots of the ship. The difference between the run with the appendage on and the run with the appendage off gives the resistance absorbed by the appendage at this particular speed (11 knots). I should like to know some method whereby I may determine the resistance absorbed by the appendage at other speeds on the resistance curve, other than running the model with the appendage on and off as above.

A. (1022).—In considering the problem of appendage resistance, it should be realized that appendage resistance in ordinary vessels is a minor matter. Admiral Taylor in his work "Speed and Power of Ships" suggests that the appendage resistance for a single-screw vessel will rarely be greater than four or five percent of the bare hull resistance, and for a twin-screw vessel this value might reach twenty percent.

The law of comparison does not hold for all parts of appendage resistance, which is made up of resistance due to bar and bilge keels, rudders, shaft bossings, blunt stem or stern frames and spectacle frames. (The resistance of such appendages as stem and stern post can be found, but for items like the bilge keel, where stream line motion comes into play, the model results cannot be safely used.) If desired, the appendage resistance at any speed can, in your case, be approximated by assuming that it varies as the square of the speed. However, since the appendage resistance will not follow this law, it will be preferable (until this subject is more clearly understood) to approximate it by comparing the calculated bare hull resistance of the ship with the total resistance of the ship as obtained from the trial.

Measurement of Vacuum

Q. (1023).—I have been using thermometers in the exhaust trunks as vacuum gages, using the temperatures given in the steam tables. Is this right, and do the temperature and pressure of steam in the exhaust trunk correspond with that given in the steam tables?

As I see it, no corrections are necessary if the barometer is up or down. Is this true?

I have used the following scale. Is this right?

29.6	54.0°	28.7	88.0°	27.8	105.0°
29.5	58.0°	28.6	90.0°	27.7	106.5°
29.4	63.0°	28.5	92.0°	27.6	108.0°
29.3	67.0°	28.4	94.0°	27.5	109.0°
29.2	71.0°	28.3	96.0°	27.4	110.
29.1	75.0°	28.2	98.0°	27.3	112
29.0	79.0°	28.1	99.5°	27.2	113.0
28.9	82.0°	28.0	101.0°	27.1	114.0
28.8	85.0°	27.9	103.0°	27.0	115.0°

A. (1023).—Although it is a common practice to use the Burdon gage for measuring vacuum, you are quite right in using the thermometer for this purpose. The temperature and pressure in the ordinary steam tables are for dry saturated steam, but as these are independent of the quality, the effect of change of the quality is to vary the specific volume and heat contents. This method of obtaining the pressure in the condenser has been used quite frequently, especially in some experiments in the design of condensers, on which Mr. D. B. Morrison has written several papers. Care should be taken, however, that the thermometer is placed in a well located at the top of the exhaust trunk or the top of the condenser, as placing same in a lower position will cause greater discrepancy, due to the fact that the mixture of air and water vapor contains more air further down.

Your data as reported in the log should refer everything to atmospheric pressure. Boiler pressure gage would require that the atmospheric pressure be added to express the result in pounds per square inch absolute. Likewise, the vacuum obtained by the manometer (U-tube of mercury) would require that the barometer be read in order to allow for the atmospheric pressure. In other words, the atmospheric pressure is being used in both the above cases as the datum plane of measurement. If the steam tables were used directly, a certain temperature would give you a corresponding absolute pressure in pounds per square inch, which can be converted into inches of mercury above zero, absolute pressure.

As most of your data in the log is in pounds per square inch gage, it would theoretically not be correct to use your table, due to the fact that it is based upon the barometer registering 30 inches, which latter will vary from day to day. The following example will serve to bring out this point quite clearly:

Find range of pressure for a low-pressure turbine, admission pressure 20 pounds gage, temperature of exhaust trunk 98 degrees F., barometer, 29.7 inches.

Steam chest pressure at turbine 14.6 + 20.0	= 34.6	pounds per square inch absolute
Pressure in exhaust trunk (see steam tables)	= .9	pound per square inch absolute
Range of pressure	= 33.7	pounds per square inch

Using your scale, we have:

Steam chest pressure at turbine	= 34.6	pounds per square inch absolute
Pressure in exhaust trunk i. e., pressure corresponding to 28 inches of mercury (14.6 — 13.85 = .75 pound)	= .75	pound per square inch absolute
	= 33.85	pounds

You will note that your scale will undoubtedly give an approximate vacuum, but it does not take account of variations in barometer. With the idea of greater accuracy, I would suggest that the first column in your table be subtracted from 30 to give absolute pressure (unit inches of mercury). If, then, these readings are subtracted from your barometer reading, we have the correct vacuum with but little more trouble than would be caused in using your scale, as at present. Of course in turbine work every tenth inch of vacuum will cause a corresponding improvement in the turbine operation, so that correct reporting of vacuum readings is important.

Disposal of Large German Liners.—The former Hamburg-American liner *Imperator* has been turned over to the Cunard Line by the British Ministry of Shipping to be operated on the express mail service between New York and Southampton with the liners *Aquitania* and *Mauretania*. It is expected that the *Leviathan* will be turned over to the International Mercantile Marine Company.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

132,000 TONS OF STEEL ORDERED FOR AMERICAN AND FOREIGN SHIPBUILDING

$80,000,000 for Foreign Tonnage. Bidding Active on Tankers

Reports issued by the steel companies show that 32,000 tons of steel have been ordered from plate mills for the construction of steel tonnage recently contracted for. Inquiries have now been received concerning an additional 100,000 tons of ship plates, 50,000 tons of which will probably be constructed in the United States. A rough estimate of $80,000,000 has been given as the expenditure for foreign ships to be built in this country and abroad.

P. A. S. Franklin, of the International Mercantile Marine, has announced that orders have been placed with Harland & Wolff, Belfast, Ireland, for 200,000 tons of freight and passenger vessels.

Eastern shipyards have been asked to bid on eight steel tankers ranging from 8,000 to 11,000 tons. A rumor appearing in the *Wall Street Journal* states that two oil companies have asked bids on six tankers of 10,000 tons each. The Atlantic, Gulf & West Indies Company, 11 Broadway, New York, is asking prices on twelve tankers.

Contract Let for Two Freighters

The Todd Shipyards Corporation, 15 William street, New York, has received a contract to build two 227-foot vessels for the Donald Steamship Company, Inc., 17 Battery Place, New York. The ships will be 33 feet 8 inches in beam, 15 feet molded depth, of about 1,200 deadweight tons. They will be equipped with two oil-fired boilers, operating under forced draft. Triple expansion engines will be installed developing 1,400 horsepower. The vessels will make 12½ knots.

Naval Architect Prepares Plans for $50,000,000 Worth of Vessels

Theodore Ferris, naval architect and marine engineer, 30 Church street, New York, is now engaged in preparing designs, plans and specifications for various merchant ships—cargo vessels, passenger steamships, colliers and bulk oil ships, which in value will exceed $50,000,000 when constructed. He is also working on several large reconstruction and alteration propositions for passenger ships and some fifteen coal-burning vessels which are being converted into oil burners.

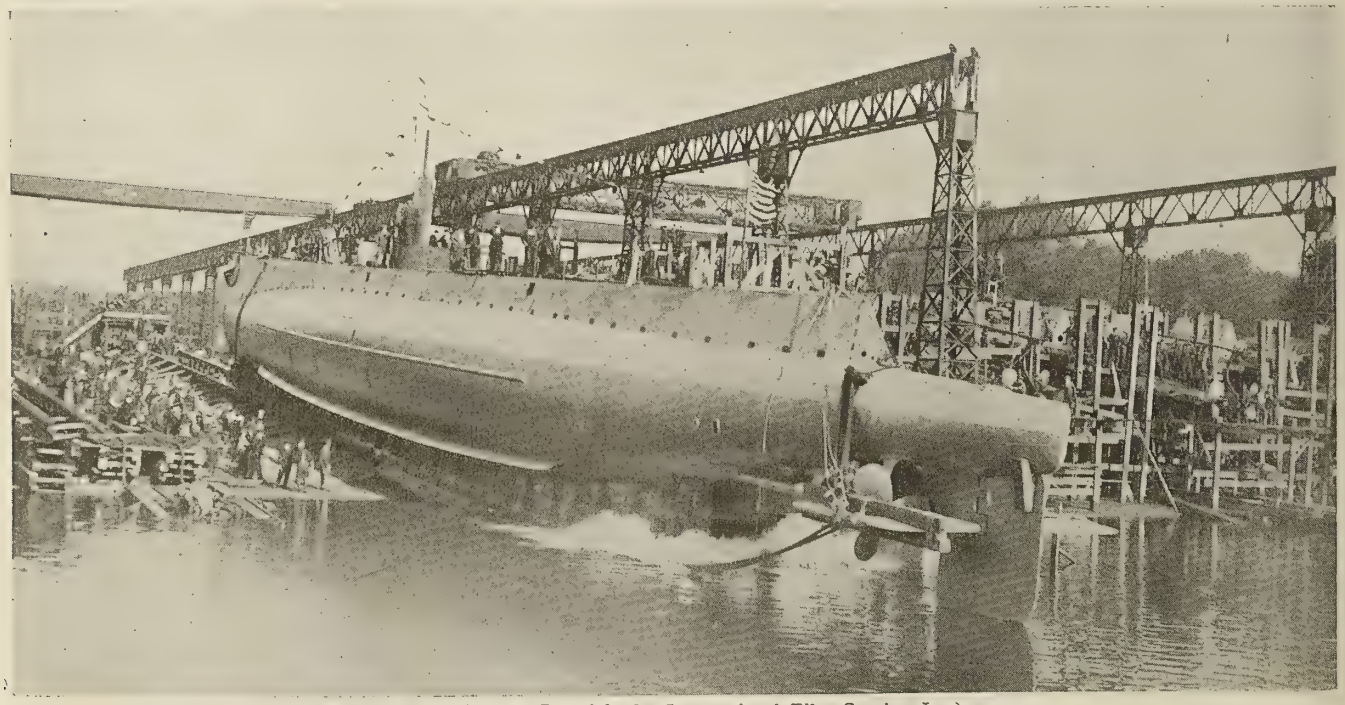
FRANCE TO SPEND $375,000,000 FOR MERCHANT MARINE

French Representative in America Unable to Report on American Contracts

On August 10 the French Cabinet consented to the introduction of a bill authorizing the expenditure of 1,380,000,000 francs ($375,000,000) in the reconstruction of the French merchant marine. On August 29 we were advised by Commander Bricard, chief construction engineer connected with the French Commission in America, 65 Broadway, New York, that no definite decision had been made regarding the allotment of construction orders to American yards.

Commander Bricard said: "It is utterly impossible to give you the French programme of marine construction because many questions are not yet settled, among which is the amount of tonnage that will be given by Germany. Before the settlement of this question we cannot give an approximate allotment of French orders between the United States, England and France."

In this connection it may be noted that French steamship owners have recently purchased forty vessels from the British Government at a total cost of £7,500,000 ($31,000,000).



(Photograph Copyright by International Film Service, Inc.)

Launching the United States Submarine *AA*-2 at the Bethlehem Shipbuilding Corporation's Fore River Plant. This 400-foot Vessel, Which is Equipped With Diesel Engines, is Designed to Make 18 Knots on the Surface and 13 Knots Submerged

STEAMSHIP COMPANIES READY TO PLACE ORDERS FOR SHIP TONNAGE DESIGNED FOR SPECIAL SERVICES

Matson Navigation Company Will Build Several Vessels—J. S. Emery & Company to Contract for Ten Vessels—Swedish Representatives Here to Ask Bids on Tramp Steamers—Other Cargo Tonnage Planned

The reports received from various parts of the country show that ship operating companies are about ready to place contracts for vessels to be used in special services. From an authentic source we learn that J. S. Emery & Company, Inc., 114 State street, Boston, Mass., is about to place a contract for ten vessels.

The Matson Navigation Company, San Francisco, Cal., we learn from reliable authority, will place orders in the near future for one large 20-knot passenger steamship, and several smaller passenger and freight steamships, of slower speed.

The United Fruit Company, 131 State street, Boston, Mass., is planning to build a number of fruit and freight steamships for use in the West Indies service.

Representatives of the Swedish-American Line are reported to be in this country in an endeavor to place contracts for at least two passenger steamships of the Stockholm type. The American representatives of this company are Furness, Withy & Company, 34 Whitehall street, New York.

In addition, the General Petroleum Company, which maintains headquarters at San Francisco and Los Angeles, operating oil fields in southern California, is planning to place a large fleet of oil steamers on the California-Seattle oil routes.

The Ocean Mail Steamship Company, San Francisco, Cal., plans to build three or four new vessels for San Francisco-South American service.

Sun Shipbuilding Company Will Build 10,000-Ton Vessel for Dutch Interests

The Sun Shipbuilding Company, Chester, Pa., has received a contract to build a 10,000-ton steel passenger and cargo vessel for Dutch interests. The steamer, which will have accommodations for 2,500 passengers, is intended for Pacific and East Indian trade and as an immigrant steamer from Rotterdam and Amsterdam to Dutch possessions.

Submarine Boat Corporation to Build Fabricated Ship

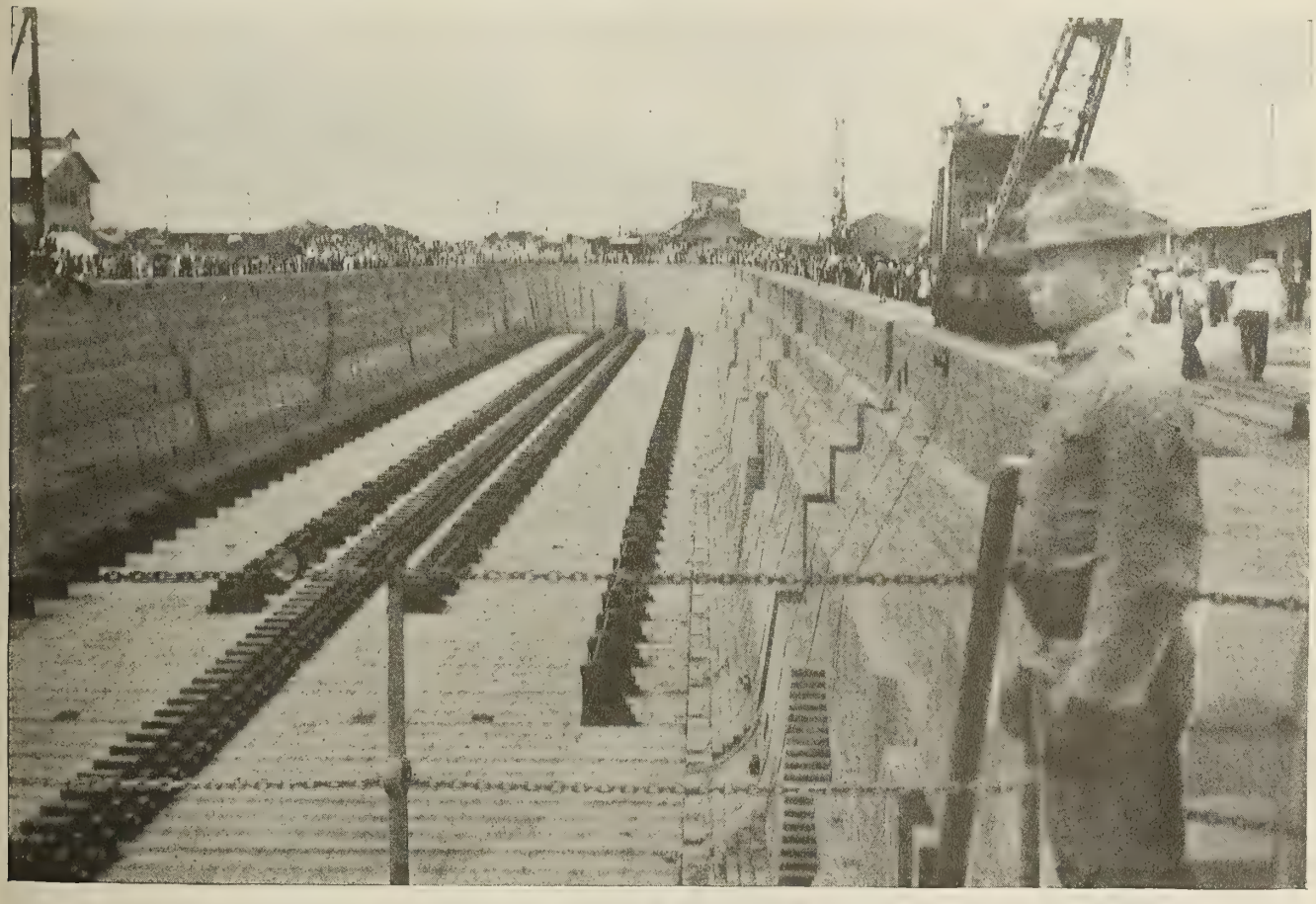
H. R. Carse, president of the Submarine Boat Corporation, Newark, N. J., has brought up for the consideration of the United States Shipping Board a proposal received from an Italian shipping company to purchase fabricated parts, machinery and equipment for a 5,350-ton steamship. The Italian corporation is also disposed to purchase four vessels of the same type and tonnage as those built by the Submarine Boat Corporation for the Shipping Board.

Six New Shipways for Baltimore

At a special meeting of the Board of Estimates of the City of Baltimore, Md., it developed that the Union Shipbuilding Company plans to spend $8,000,000 for extensions on the Brooklyn side of the Patapsco River. The extensions include the building of six additional concrete ways and the construction of four railroad tracks to route materials.

Tidewater Shipbuilders Building Machine Shop

The Tidewater Shipbuilders, Ltd., Three Rivers, Que., plans the construction of a $50,000 machine shop. M. Mapes, Windsor Station, Montreal, Room 401, is the naval architect.



(Copyright, Underwood & Underwood, N. Y.)

View of the New Drydock at Pearl Harbor, Honolulu, Which Was Recently Opened by Secretary Daniels

FLEET CORPORATION PROGRAMME TOTALS 9,205,776 GROSS TONS—984,407 TONS YET TO BE BUILT

According to figures just issued by the United States Shipping Board vessels aggregating 4,750,150 gross tons had been delivered by the Board on August 29, 1919. Vessels totalling 4,555,626 gross tons yet to be completed will bring the building programme up to 2,424 vessels with a gross tonnage of 9,205,776. Details are given in the following table:

VESSELS CONSTRUCTED BY THE SHIPPING BOARD

Delivered from 1917 to August 29, 1919

	Description	Gross Tonnage	Total
899	steel ships	3,822,415	
378	wood ships	892,735	
15	composite ships	35,000	4,750,150

Vessels Launched But Not Yet Delivered

	Description	Gross Tonnage	Total
408	vessels	1,280,483	1,280,483

Vessels on Ways

	Description	Gross Tonnage	Total
389	steel ships	2,010,403	
99	wood ships	138,000	
9	concrete ships	42,333	2,190,736

Vessels Contracted For; Work Not Begun

	Description	Gross Tonnage	Total
227	steel ships	984,407	984,407
2,424			9,205,776

An accurate record of the production by months during the year ending August 29, 1919, is shown in the accompanying table, which gives the deliveries of steel, wood and composite ships in gross tons:

Of the 3,687 vessels (100 gross tons and over), totaling 11,983,000 gross tons, which were recorded by Lloyd's Register as operating under the American flag on June 30—24.8 percent of the world's tonnage—1,280 ships with a gross tonnage of 5,313,780 were under the control of the Shipping Board on August 29. The following table gives the sources from which these vessels were acquired:

VESSELS CONTROLLED BY THE SHIPPING BOARD

Source	Number of Vessels	Gross Tonnage
Built by Shipping Board—		
Steel	777	3,511,918
Wood	315	728,079
Composite	15	35,000
Seized from Germany	94	567,490
Seized from Austria	5	8,312
Purchased from Japan	15	85,880
Purchased from Austria	5	30,521
Requisitioned from private owners	58	346,580
	1,280	5,313,780

The foregoing tabulation does not include 122 steel ships of 465,745 (deadweight) tons and 63 wood ships of 246,982 (deadweight) tons sold recently to private owners by the United States Shipping Board, nor seized foreign vessels that had been sunk.

SHIPPING BOARD DELIVERIES FOR THE YEAR ENDING AUGUST 29, 1919

	Steel		Wood		Composite		Totals	
1918	Number	Gross Tons	Number	Gross Tons	Number	Gross Tons	Number	Gross Tons
September	46	178,430	25	59,334	1	2,333	72	240,097
October	47	200,739	29	69,467	1	2,333	77	272,539
November	54	215,121	10	22,667	..	.....	64	237,788
December	30	156,260	15	36,467	1	2,333	46	195,060
1919								
January	17	88,070	7	16,667	1	2,333	25	107,070
February	27	129,933	8	16,900	2	4,667	37	151,500
March	31	136,017	11	26,700	..	.....	42	162,717
April	78	290,580	36	86,800	1	2,333	115	379,713
May	89	407,733	53	129,500	2	4,667	144	541,900
June	71	279,572	51	118,767	1	2,333	123	400,672
July	72	327,005	63	145,933	1	2,333	136	475,271
August (29th)	56	255,050	37	84,867	2	4,667	95	344,584
Totals	618	2,664,510	345	814,069	13	30,332	976	3,508,911

Bryant Plugs and Receptacles for Marine Use

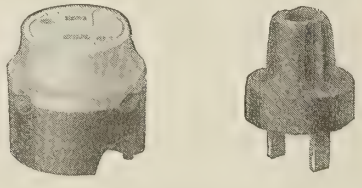
The receptacles and plugs shown herewith are properly adapted for marine use where non-watertight extension cord outlets are desired in officers' quarters, mess rooms, cabins and staterooms.

The base of this plug receptacle is unbreakable composition; the top section is hard, white porcelain, glazed. This receptacle has a bottom diameter of 1¾ inches, top diameter of 1⅜ inches, and height of 1 13/16 inches. A groove of ample size is provided in the base to allow wire entrance from the bottom of the box. Brass fastening screws of 6/32 inch are furnished, and kept in place by holding washers. Screw centers are 1⅜ inches, the standard for all Bryant marine devices.



Plugs for Marine Use

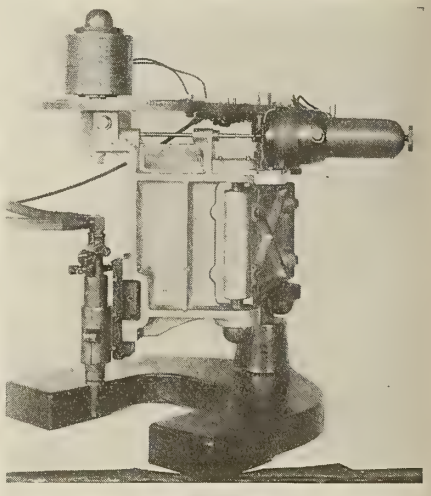
Caps are provided for use on small size flexible cords not over 13/32 of an inch in diameter, and for heavy insulated or metal armored cables up to 9/16 inch in diameter. The latter are provided with a strain relief clamp and cord grip. Both types of caps are made of unbreakable composition which will stand severe usage.



Special Caps for Flexible Cords

Machine for Cutting Handholes and Other Openings in Steel Plates

The device known as the Camograph No. 2 was specially designed by the Davis-Bournonville Company, Jersey City, N. J., to cut handholes in boiler plates, and similar openings in ship plates and other wrought iron and steel sections. An oxy-acetylene flame perforates the steel, and the path traversed is controlled by an internal cam at the top, the shape of which determines the shape of the opening made. The machine is suited for cutting all openings in steel plates that cannot be produced quickly and economicaly on a drill machine. A handhole having a periphery of 12 to 13 inches can be smoothly cut in ½ to ⅝-inch steel plate.



Camograph No. 2, for Cutting Handholes

The machine comprises a cast iron base with a U-shape opening through which the torch flame strikes the work beneath. At the back of the base is a vertical post to which a double-jointed radial arm is pivoted. The cutting torch is mounted on the outer end of the radial arm which provides for movement in any direction over the entire area covered.

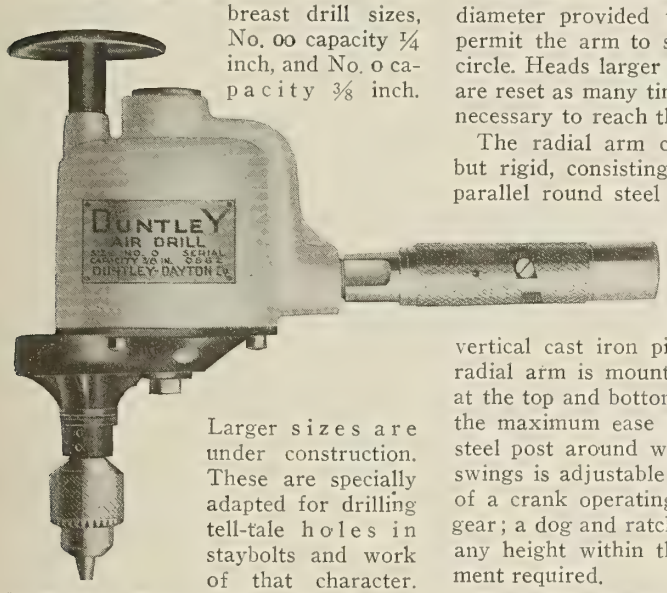
The shape of the opening cut in the plate being determined by the shape of the cam, it is necessary, therefore, to provide a cam plate for each shape required. The cam plate fits into a circular opening in the yoke or cam holder, and is readily removed and replaced by another. The nominal diameter of the largest hole cut with the No. 2 Camograph is 7 inches, but openings other than circular having one dimension much larger may be provided for. All thicknesses of plates used on the largest marine boilers are readily cut; while intended for cutting commercial steel plates only the power of the torch is ample for cutting much thicker metal, should it be required.

New Air Drill

In the new air drill just placed on the market by the Duntley-Dayton Company, 1416 Michigan Ave., Chicago, there

is a radical departure from standard air drill construction which makes the drill unique. The motor or power unit is quickly detachable, making it possible by the removal of three screws and a nut to replace the motor should this become necessary.

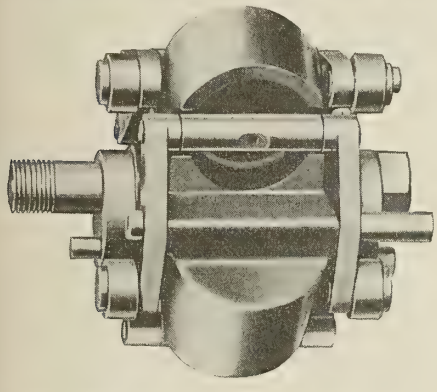
The line thus far consists of two breast drill sizes, No. 00 capacity ¼ inch, and No. 0 capacity ⅜ inch.



New Type of Duntley Air Drill

Larger sizes are under construction. These are specially adapted for drilling tell-tale holes in staybolts and work of that character. As the motor is self-contained and well balanced, there is no vibration, a desirable feature in the performance of accurate work. The drill weighs 4½ pounds.

The self-contained motor consists of three pistons mounted in a frame, the



Detachable Motor or Power Unit for Duntley Air Drill

entire engine rotating about a fixed crankshaft or spindle. The cylinders oscillate from a fixed base and cams on the spindle operate the valves. All working parts run in a bath of oil.

Cutting Machine for the Boiler Shop

A device known as the Pyrograph for trimming and beveling boiler sheets to correct the flange height and calking angle in one operation, by means of the oxyacetylene torch, has been placed on the market by the Davis-Bournonville Company, Jersey City, N. J.

The Pyrograph comprises a motor-driven carriage supported on a radial arm of length that provides for cutting the flange of a 9-foot diameter boiler head at one setting. While the largest diameter circle that can be cut at one setting is 9 feet, much larger work may be trimmed and beveled, inasmuch as the arm can be swung through a semi-circle of 20 feet or a full circle of 20 feet diameter provided the shop conditions permit the arm to swing in a complete circle. Heads larger than 9 feet diameter are reset as many times as may be found necessary to reach the flange all around.

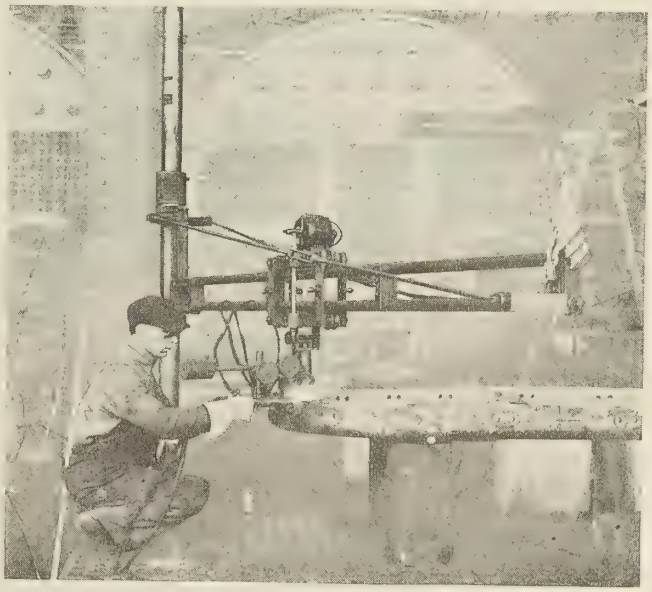
The radial arm construction is light but rigid, consisting of two cold-rolled parallel round steel bars firmly tied together by end connections and intermediate spacer blocks, supported by a truss rod. The vertical cast iron pivot member of the radial arm is mounted on ball bearings at the top and bottom in order to insure the maximum ease of movement. The steel post around which the radial arm swings is adjustable vertically by means of a crank operating a rack and pinion gear; a dog and ratchet holds the post at any height within the limits of adjustment required.

The column has a broad flanged base which may be bolted to a cast iron floor-plate or a concrete foundation if required to be self-supporting, or the top of the post may be shackled to a column of the ship building and the base supported on an ordinary floor without an individual foundation.

The carriage is supported on the radial arm by four grooved ball bearing rollers which provide for the easy radial movement required to follow the feed action freely. The carriage and the arm derive their movements from the feeding mechanism which operates directly on the part to be beveled, the flange part itself acting as the track and guide for the feeding mechanism.

The torch is adjustably mounted on the carriage beneath the radial arm, and the tip may be directed at any angle required to cut to the desired calking angle. The adjustment provides for setting the tip to all angles from the vertical to the horizontal.

The vertical adjustment provided at the column is 18 inches, which is ample for all ordinary boiler flange work and many other uses. The machine may be adapted to straight line cutting and beveling the edges of flat plates by adjusting the torch for vertical cutting and providing means of engagement for the feed rollers.



Pyrograph for Trimming and Beveling Boiler Plates

Report on Cutting & Washington Radio Sets

The following is an excerpt from an interesting report received by Cutting & Washington, Inc., Cambridge, Mass., from the radio operator on the steamship *August,* a Norwegian vessel which is making a tour of the world under charter by J. H. Winchester, of the Produce Exchange, New York:

"The set has been giving perfect satisfaction throughout. There really is nothing that I would suggest by way of improvements, unless it be the introduction of some rectifier tube in place of the crystal detector (a change which all radio operators know is impossible, owing to the rather complicated patent situation at present).

"On the night of October 20, 1918, the ship, loaded with a cargo consisting solely of cased kerosene and gasoline, caught fire while at sea. The ship was at the time in the latitude of Tiensten. In spite of heavy interference from Japanese stations in the immediate vicinity, who did not answer the S O S, communication was established with the French station at Shanghai (the distance covered was about 500 miles, mostly over land)."

An Improved Paint for Smoke-stacks

Quite as necessary as the adequate upkeep of plant buildings and equipment by frequent painting is the necessity for the proper care of smokestacks. When a smokestack is "put out of business" with rust it means new construction and possibly a shut down of the entire plant. A special smokestack paint is now being put on the market by E. I. Du Pont de Nemours & Company, Wilmington, Del.

Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIP CONTRACTS

Messrs. Cammell Laird & Company, Birkenhead, England, has recently received a contract for a high-class steamer of 20,000 tons displacement from the Compagnie Generale Transatlantique. The vessel will be constructed and completely equipped at Birkenhead, where the vessel will be laid down as soon as a berth is available. The propelling machinery will consist of double reduction geared turbines.

The Coastwise Shipbuilding Company, Baltimore, Md., we have now been advised, is negotiating to build six four-masted schooners; four of these vessels of 2,000-tons deadweight will be constructed for the Inter-American Transportation Company, and two for the Chesapeake & South American Transportation Company.

The Consolidated Shipbuilding Corporation, Morris Heights, N. Y., has entered the lowest bid of $357,250 for building the single screw steel steam propelled lighthouse tender upon which bids were recently called.

The Gray's Harbor Motorship Corporation, Aberdeen, Wash., has laid keels for five 260-foot barkentines to be built for its own account. These vessels will be used in United Kingdom lumber trade. The ships will be made ready for engines, but these will not be installed until after the first voyage.

Harland & Wolff, Belfast, Ireland, have received a contract to build a 16,000-ton passenger steamship for the White Star Line, 9 Broadway, New York.

The Herreshoff Manufacturing Company, Bristol, Conn., has received an order to build an 80-foot schooner yacht for Carl E. Tucker, New York, for the 1920 racing season.

The Hodge Ship Company, Moss Point, Miss., is now building vessels of the Ferris type for its own acount. One vessel is now on the ways. The company has four ways, capable of building vessels up to 7,000 tons complete with machinery.

The Howard Shipyards & Dock Company, Jeffersonville, Ind., is constructing five oil barges for the Great Northern Refining Company, Lytton building, Chicago, Ill. These barges are of wood, 130 feet long, 25 feet beam and 7 feet 3 inches draft. The Cairo Manufacturing Company, Cairo, Ill., has received a similar order from the Great Northern Refining Company.

The Howes Construction Company, Meteghan, N. S., has received a contract to build a bay steamer for the Valley Steamship Company to replace the Granville.

The International Ship Building Company, Pascagoula, Miss., it is reported, is about to conclude contracts for the building of six 10,000-ton vessels.

The Manitowoc Shipbuilding Company, Manitowoc, Wis., has received a contract to build two 3,200-ton deadweight fruit steamers for the Atlantic Fruit Company, 61 Broadway, New York.

McGill & McKay, Shelburne, N. S., are building four knockabout fishing vessels for J. N. Rafuse & Sons. The latter company will shortly launch a 326-ton tern schooner from its Salmon River yards.

The Mobile Shipbuilding Company, Mobile, Ala., it is reported, has received new contracts for twelve 5,000-ton steel ships.

Napier & Miller, Glasgow, Scotland, has received a contract from the Norwegian-American Line, 8 Bridge street, New York, for two 435-foot vessels of 9,000 gross tons. These ships will be constructed to burn either fuel oil or coal. Parsons turbines will be installed. The same company will build two 7,500-ton cargo vessels equipped with triple expansion engines.

The Norway-Pacific Construction & Dry Dock Company, Everett, Wash., under the direction of the new superintendent, R. Elwood Ellis, has laid two keels for the United States revenue cutters which the company is building.

The Oswall Towing Company, Three Mile Creek and Telegraph Road, Mobile, Ala., is building a large barge for carrying lumber.

The Murnan Shipbuilding Corporation, Mobile, Ala., is building two large mud scows for the Ollinger and Perry Dredging Company, Mobile, and one collier for the Coyle Coal Company, New Orleans, La., as well as a collier for the Mobile Coal Combuild two 13,000-ton vessels for the Emerwhen machinery is installed.

The Pusey & Jones Company, Gloucester, N. J., and Wilmington, Del., has received a reinstatement on the company's contract to build two 13,000-ton vessels for the Emergency Fleet Corporation.

James Rees & Sons Company, Pittsburgh, Pa., is constructing a towboat for the Carnegie Steel Company.

The G. M. Standifer Construction Company, Portland, Ore., has announced that it will build five 9,500-ton steel steamers on its own account. This company at the Vancouver, Wash., yard recently received reinstatements on the Montezuma and the Arizona, which had already been launched.

Stevens Brothers, Stockton, Cal., are constructing the following vessels: two 50-foot wooden twoboats for the Island Transportation Company, one 65-foot vessel equipped with a six-cylinder Wisconsin motor for Pollard Brothers, and one 40-foot, raised-deck, runabout cruiser for the Bay and River Dredge Company.

The Sun Shipbuilding Company, Chester, Pa., has received a contract to build a 10,000-ton cargo and passenger vessel for Dutch interests.

The Tacoma Ship Building Company, Tacoma, Wash., is constructing a motorship for the Chicago Mining Company.

The Todd Shipyards Corporation, Inc., 15 Whitehall street, New York, has received a contract from the Donald Steamship Company, Inc., 17 Battery Place, New York, for two 227-foot vessels of about 1,200 deadweight tons. The vessels will be equipped with two oil-fired boilers operating under forced draft. Triple expansion engines will be installed developing 1,400 horsepower; the vessels will make 12½ knots.

Messrs. Vickers, Ltd., Barrow-in-Furness, England, it is reported, has received a contract from W. M. Hughes, Premier of the Commonwealth of Australia, for three large cargo steamers. These vessels, it is understood, will be driven by geared turbines and will burn oil fuel. The ships will be 530 feet long, 68-foot beam and 29-foot molded depth.

The Vinyard Ship Building Company, Milford, Del., has secured a contract to finish two 88-foot tugs. The boilers of these ships were built by the International Boiler Works Company, East Stroudsburg, Pa., and the feed-water heaters by Griscom-Russell Company, New York.

PROSPECTIVE SHIP CONSTRUCTION

Two Passenger Steamships for Swedish Interests.—Representatives of the Swedish-American Line are reported to be in this country in an endeavor to place contracts for at least two passenger steamships of the Stockholm type. The American representatives of this company are Furness, Withy & Company, 34 Whitehall street, New York.

Boats for River Service.—The Liberty Transit Company, operating a fleet of packets on the Ohio River, plans to place additional boats in service. No specifications have yet been issued regarding these vessels.

Dredges, Houston Ship Canal, Tex.—Specifications are issued for four dredges which will be used in deepening the Houston Ship canal. Bids should be submitted to General Harry Taylor, United States Engineer Office.

Fruit and Freight Steamers, Boston, Mass.—The United Fruit Company, 131 State street, Boston, Mass., is planning to build a number of fruit and freight steamships for use in the West Indies service. John Hudson, pier 9, North River, New York, is the superintending engineer of the company. Maurice Eckstein, supervisor of purchases, is located at the same address.

Oil Burning Vessels, Boston, Mass.—The Fidelity Steamship Company, Boston, Mass., intends to acquire a fleet of six or eight oil-burning steamers to engage in foreign trade. This company has been formed by Boston business men, with a capital of $2,000,000. Captain Arthur L. Crowley, vice-president of the Coastwise Transportation Company, is president and general manager, and A. L. Stark is treasurer.

Oil Steamers and Terminal, Harbor Island, Seattle, Wash.—The General Petroleum Company, which maintains headquarters at San Francisco and Los Angeles, operating oil fields in southern California, is planning to place a large fleet of oil steamers on the California-Seattle oil routes. The company plans the building of a large oil terminal on Harbor Island, Seattle, capable of storing 165,000 barrels. Delivery of oil in Seattle will be made by a fleet of barges, which the company plans to construct.

Ship for Automobile Trade, Detroit, Mich.—The Detroit and Cleveland Navigation Company, Detroit, Mich., is preparing plans and specifications for a 300-foot ship, which will be used in the automobile trade of the company. The boat will be of 75-foot beam; two elevators will be installed opposite the double hatches. Turntables will be installed on each deck. Frank E. Kirby is the naval architect of the company.

Ten Vessels, Boston, Mass.—It is reported that J. S. Emery & Company, Inc., 114 State street, Boston, Mass., is about to place a contract for ten vessels.

Motorboats for Mexican Trade, Los Angeles, Cal.—Charles A. Wiley, president of the Exchange National Bank, Los Angeles, Cal., has been made president of a new $500,000 concern which will operate vessels from Long Beach, Cal., to Mexican ports. The company will utilize motorboats in this service. One vessel of this type is already under construction.

Ferry Boat and Terminals, Baltimore, Md.—The Peninsula Ferry Company, Baltimore, Md., has recently increased its capital stock. The proceeds will be used in purchasing a ferry boat to be operated from Baltimore to Love Point, and in acquiring terminals. The ferry boat as constructed will have a capacity for 30 vehicles and 1,000 passengers.

Three Vessels for Pacific Coast Service, San Francisco, Cal.—The Ocean Mail Steamship Company, San Francisco, Cal., plans to build two or three steamers for coastwise trade. This company has been organized by Oliver J. Olson to carry on trade between San Francisco, Mexico and South America. Two steamers are now operated in this service.

NEW SHIP CONCERNS AND SHIPYARD EXTENSIONS

Drydock Pontoons, Kingston, N. Y.—The Kingston Shipbuilding Corporation, Kingston, N. Y., is constructing a drydock of eight sections, each 116 feet wide. The lifting capacity of each of these sections is calculated to be 2,000 tons. Five sections will probably be used as a drydock. Construction is started on three of the sections and the entire job will be completed in the early spring. The work is being carried out for the Emergency Fleet Corporation.

Drydock Pontoons, Tiverton, R. I.—The Narragansett Ship Building Company, Tiverton, R. I., has received a contract to build eight pontoons for a 12,000-ton floating drydock. These pontoons will be operated in units of five. Each pontoon is 116 feet long, 80 feet wide and 16 feet broad, exclusive of wings. The latter are 45 feet high, 16 feet at the base, 10 feet at the top and 80 feet long.

Drydock, Retaining Walls and Wharves, Chelsea, Mass.—The Winnisimmet Shipyard, Inc., Chelsea, Mass., has begun the construction of its 3,500-ton railway drydock, including the retaining walls and wharves to be used in conjunction with it. The Crandall Engineering Company, drydock engineers, East Boston, Mass., are the designers of the drydock and are superintending the construction.

Machine Shop, Power Plant and Woodworking Shop, Kewaunee, Wis.—The Wisconsin Shipbuilding & Navigation Corporation, 216 West Water street, Milwaukee, Wis., has placed a contract with McMullen & Pitz, consulting engineers, Manitowoc, Wis., for a machine shop, power plant, woodworking shop and other buildings, to cost in all $75,000. This construction will be used in connection with the company's new steel shipyard at Kewaunee, Wis.

Machine Shop, Three Rivers, Que.—The Three Rivers Shipbuilding Company, Three Rivers, Que., is adding a machine shop to its plant on Notre Dame street.

Marine Electrical Company, Galveston, Tex.—The Marine Electrical Corporation has been organized at Galveston, Tex., to handle all repairs and installations of electrical equipment for ships at this port. The officers of the company are: J. B. Gribble, Jr., president; Conley Lloyd, vice-president, and J. Hamilton Mills, secretary and treasurer.

Marine Railway, Mobile, Ala.—Harrison Brothers, Palmetto street, Mobile, Ala., have just completed an addition to their ship repair plant of a 500-ton marine railway. In addition to repair work the company handles the construction of barges, launches and schooners.

Pattern Shop, Philadelphia, Pa.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract to M. H. McClosky, Jr., 1620 Thompson street, Philadelphia, Pa., for building a pattern shop at the Philadelphia Navy Yard.

Ship Chandlery Company Reorganized, New York, Philadelphia, Baltimore.—The ship chandlery company, known as the S. P. Blackburn Company, with offices at 13-15 Coenties Slip, New York, 129 South Second street, Philadelphia, and 510 East Lombard street, Baltimore, has been taken over by the Joseph J. Keegan Company, composed of Joseph J. Keegan, A. Frank Stafford, James C. Lynch, Harvey E. Busch and Charles W. Geiger.

Shipbuilding Company, Mobile, Ala.—The Kelly Shipbuilding Company is the name of the new concern which has recently located on the east side of the Mobile river opposite the foot of Beauregard street, Mobile, Ala. The plant at present consists of a fully equipped marine railway, capable of handling vessels up to 1,800 tons. The officers of the company are: Thomas J. Kelly president; L. L. Bodden, vice-president, and E. A. Kelly, secretary.

Shipbuilding Company, New Orleans, La.—The Kayser-Hagedorn Engineering Works, Inc., New Orleans, La., is a new concern which has just been organized to specialize in shipbuilding, both heavy and light, as well as machine and casting business.

Shipbuilding Company, Rossie Island, Mountrose, N. B.—The Coaster Construction Company, Glasgow and Mountrose, N. B., has completed the initial layout of the shipyard at Rossie Island, Mountrose, for the construction of coastal vessels, tugs, barges, etc. The yard covers an area of 20 acres, and can accommodate vessels up to 360 feet in length.

Shipyard Combine, Marshfield, Ore.—The Coos Bay Shipbuilding Company, Marshfield, Ore., will be combined with a sawmill to be erected on 26 acres of land adjoining it. The new company will be a stock concern, in which A. E. Adelsperger and W. J. Conrad, of Marshfield, Ore., are interested.

Shipyard Conversion, Warrenpoint, Ireland.—The Liberty Shipbuilding and Dry Dock Company, Warrenpoint, County Down, Ireland, has been changed from a concrete to a steel shipbuilding yard. Keels of two fair-sized steel steamers have already been laid. These vessels, it is said, will be built almost entirely by the electric welding process.

Shipyard Discontinued, Portland, Ore.—The Grant Smith-Porter Ship Company, Portland, Ore., has turned over its yard to the United States Shipping Board. The plant will be used as an assembly yard for salvage materials.

Shipyard Extension, Baltimore, Md.—The Union Shipbuilding Company, Baltimore, Md., plans to spend $8,000,000 for extensions on the Brooklyn side of the Patapsco River. The extensions include the building of six additional concrete ways and the construction of four railroad tracks to route materials.

Shipyard Improvements, Mobile, Ala.—The Henderson Shipbuilding Company, Mobile, Ala., is erecting steel extensions 60 feet wide by 10 feet long to its main building as a further aid in the swift repair of vessels at the plant.

Shipyard Reorganization, Portland, Ore.—The Martinolich Shipbuilding Company, Portland, Ore., has been purchased by John L. Roberts, president of the Puget Sound Iron & Steel Works. The sale price does not include auxiliary schooners under construction for Norwegian interests.

Shipyard Reorganization, Tampa, Fla.—Philip Shore, Tampa, Fla., has taken over the plant of the Gulf Shipbuilding Company. Additional machinery, it is reported, will now be installed.

Shipyard Reorganization, Vancouver, Wash.—The Reed Engineering Company, Vancouver, Wash., has acquired the physical property and business of the Motorship Construction Company of that city. The latter company was founded in 1917 by Merrill A. Reed and S. S. Hewett. The Oregon Shipbuilding Company was later consolidated with the Motorship Construction Company. During the war this company turned out the largest contracts for steel life boats on the Pacific Coast, averaging ten a day. In addition the company built 32 cutters for the Bureau of Construction and Repair of the United States Navy. The incorporators of the new company are Merrill A. Reed, Dr. R. D. Wiswall and W. J. Kinney.

Shipyards, Glasgow, Scotland.—Harland & Wolff, Belfast shipbuilders, Belfast, Ireland, have recently acquired two new shipyards, one of these run by its competitor, D. & W. Henderson, Ltd., Glasgow, Scotland, and the other by A. & J. Inglis, also of Glasgow.

Steamship Company, New York.—The Crescent Steamship Lines, Inc., has recently been formed, with a capital of $1,000,000, with Edward J. Dalton, formerly vice-president, treasurer and chief operator of the Triangle Steamship Company, as president and treasurer of the new company. Temporary offices have been opened at Room 701, 44 Whitehall street, New York.

PROPOSED CONSTRUCTION

Coaling Wharf and Central Power Plant, New Orleans, La.—The Algiers Navy Yard, New Orleans, La., is about to begin construction of a coaling wharf to cost $100,000 and the building of a central power plant to cost $280,000.

Docks and River Terminals, Pascagoula, Miss.—The sum of $75,000 is available for the construction of docks and river terminals at Pascagoula, Miss., to be used in connection with the coal and general freight handled on the Mississippi-Warrior river line.

Drydock, Vancouver, Wash.—A. L. Haley, engineer of the Vancouver, Wash., Port Commission, is urging the construction of a floating drydock capable of handling vessels of 12,500 tons capacity. For this construction he proposes a site near the Standifer shipyard. The G. M. Standifer Construction Corporation, Vancouver, Wash., it is reported, will donate $100,000 to build this drydock, if the Government appropriates $150,000 and the city $100,000.

Floating Drydock, Sparrow's Point, Md.—The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., we are officially advised, is preparing plans for a new floating drydock of about 6,000 tons capacity to be erected at Sparrow's Point. Unofficially we learn that this construction will be 400 feet long, 80 feet wide and 20 feet deep. The drydock will be electrically equipped.

Harbor Development, Birmingham, Ala.—The City of Birmingham, Ala., is planning the construction of a temporary port at Birmingham for the immediate requirements of the traffic. Charles Francis Wood, chief engineer, 1803 Jefferson County Bank building, is preparing plans and specifications for letting contracts for this work within thirty days. At least two locomotive cranes, one small switching engine and a number of belt or pan conveyors will be installed in the port, which will probably be in operation by January 1, 1920. Eventually freight-handling equipment to cost between $2,500,000 and $3,000,000 will be installed at this port. The Warrior River Development Committee has voted to incorporate the "Port of Birmingham Company," with a capital of a minimum of $600,000 authorized and a minimum of $150,000 paid in. This company will work for the permanent development of the port of Birmingham.

Machine Shop, Three Rivers, Que.—The Tidewater Shipbuilders, Ltd., Three Rivers, Que., plans the construction of a $50,000 machine shop. M. Mapes, Windsor Station, Montreal, Room 401, is the naval architect.

Oil Terminal, East Providence, R. I.—The New England Oil Company, Devonshire street, Boston, Mass., plans to erect a $1,500,000 oil terminal at East Providence, R. I., on a 176-acre site. H. D. Corcoran is the manager of the concern.

Piers and Coal Docks, Jacksonville, Fla.—The Southern Coal Company, Jacksonville, Fla., has been incorporated to construct piers and coal docks at that city. The officers of the company are: F. W. Eanson, president; R. B. Tupper, vice-president, and J. E. Baines, secretary and treasurer.

Ship Repair Plant, Chester, Pa.—The Merchant Shipbuilding Corporation, Philadelphia, Pa., announces that it has not yet arrived at a definite decision regarding the project of building a ship repair plant at its Chester yard.

Ship Repair Plant, Staten Island, N. Y.—The Morse Dry Dock & Repair Company, Brooklyn, N. Y., has recently purchased an extensive tract of land on Staten Island, N. Y. The company is not in a position at this time to announce its plans regarding the purchase, but it is reported that construction work of a new repair plant will probably be begun upon the site early in 1920.

Shipbuilding Company, Trenton, Mich.—The Purdy Boat Company, capitalized at $75,000, has recently purchased a tract of land at Trenton, Mich., upon which the company will erect a shipbuilding plant to construct cruisers and other boats of the same character as are now built at the yard in Miami Beach, Fla.

Shipyard, Hebburn Colliery, Scotland.—George Renwick, M. P., well-known Newcastle shipbuilder, will shortly begin the construction of a new shipyard near Hebburn Colliery. R. S. Dalgliesh, another Newcastle shipbuilder, is said to be connected with the development.

Shipyard Extension, Jersey City, N. J.—The Morgan Engineering Company, Jersey City, N. J., will enlarge its present plant to include two large drydocks for ship repair work.

Terminal Developments, Ship Canal, Tex.—Private interests are planning extensive terminal developments, including steamship piers to be built on the Texas ship canal. The project is now being financed. R. H. Baker, Union National Bank building, Houston, Tex., staes that details will be issued as the proposition develops.

HARBOR CONSTRUCTION

Bulkhead, Philadelphia, Pa.—The McLean Construction Company, Philadelphia, Pa., has submitted the lowest bid for the construction of the Schuylkill River bulkhead at Philadelphia, Pa.

Concrete Caisson Breakwater and Lighthouse Crib, Indian Harbor, Ind.—The Great Lakes Dredging & Dry Dock Company, Chicago, Ill., will construct a concrete caisson breakwater and lighthouse crib at Indian Harbor, Ind., to cost about $105,000.

Concrete Pier, Baltimore, Md.—The McLean Contracting Company, 1412 Fidelity building, Baltimore, Md., has received a contract from the Baltimore & East Shore Ferry Company, Inc., 110 East Lexington street, Baltimore, Md., to build a reinforced concrete pier to cost about $100,000.

Dredging, Schuylkill River, Pa.—The American Dredging Company has received a contract for dredging in the Schuylkill River to cost about $25,000. The Maryland Dredging & Contracting Company has received a similar contract for work involving over $342,000.

Dredging, St. John's River, Fla.—P. Sanford Ross, Jersey City, N. J., has received a contract for dredging in St. John's River, Fla. The work wil cost about $105,000.

Harbor Improvements, Vancouver, B. C.—About $18,000 has been spent in improving the harbor at Vancouver, B. C.

Harbor Improvements, Victoria, B. C.—About $21,000 has been spent in improving the harbor at Victoria, B. C.

Pier Extension, Sandusky, O.—The Pringle Barge Line Company, Sandusky, O., has awarded a contract to the Stanton Brothers Company, Cleveland, O., for the extension of its docks at the foot of Lawrence street.

EQUIPMENT

Dipper Dredge, New York City, N. Y.—Colonel Richard T. Coiner, United States Army Engineer, Room 710, Army building, New York City, will receive bids until October 10 for the construction and delivery of a dipper dredge. Complete specifications will be furnished on application.

Diesel Engines, Greece.—The commercial reports of the Department of Commerce state that there is a large demand in Greece for marine engines of from 50 to 200 horsepower. These are chiefly oil engines of the Diesel type. The two main considerations are simplicity of construction and operation and economy of fuel consumption.

Elevators, Detroit, Mich.—The Detroit and Cleveland Navigation Company, Detroit, Mich., will install two elevators for handling automobiles on a 300-foot vessel, which the company is planning to construct. Frank E. Kirby is the marine architect of the company.

Metal Lifeboats, Mobile, Ala.—The Mobile Steel Company, Mobile, Ala., has just completed a Government order for furnishing 300 metal lifeboats for the Navy. These boats were shipped to the Navy Yards at New York, Philadelphia and Norfolk.

Outfitting Vessels, Victoria, B. C.—The Cholberg Shipyard Company, Victoria, B. C., has received a contract to complete and outfit three wooden vessels which the Universal Shipping & Trading Company recently purchased from the Shipping Board.

Spars and Top Masts, Wilmington, Del.—The Columbia Spar Company, Orange, Tex., has received a large order for spars and top masts for shipbuilders in Wilmington Del. The company also holds an order for thirty-two 85-foot spars.

Turn Tables, Detroit, Mich.—The Detroit and Cleveland Navigation Company, Detroit, Mich., will install turn tables on each deck of a 300-foot vessel which the company is planning to construct. Frank E. Kirby is the marine architect of the company.

Wireless Sets.—The Marconi Wireless Telegraph Company of America, Woolworth building, New York, has recently received a contract to outfit 81 ships of the Standard Oil Company with Marconi sets. According to an announcement by Arthur Isbell, district superintendent, about 90 percent of the privately owned ships on the Atlantic Coast are fitted with wireless sets of the company.

GOVERNMENT SUBMARINE CHASERS AND YACHTS FOR SALE

Motor Submarine Chasers and Yachts, Washington, D. C.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will sell on October 8 a large quantity of 110-foot seagoing motor boats used by the Navy during the war. These submarine chasers have wooden hulls, built on the lines of a trawler, so that they can stay out in heavy weather. The vessels are equipped with three 220-horsepower, six cylinder, heavy duty gasoline engines. On October 15, five motor yachts ranging from 44 to 94 feet in length will also be offered for sale.

Marine Engineering Representatives

New England Manager: S. I. Carpenter, 294 Washington Street, Boston, Mass.

MARINE ENGINEERING may be purchased at the following News Stands:

Boston, Mass.
Old Corner Book Store, 27-29 Bromfield Street

New York City, N. Y.
Produce Exchange, Beaver Street
Whitehall Building News Stand, 17 Battery Place
Eastern Hotel News Stand, Whitehall and South Street

Baltimore, Md.
L. T. Taylor, 2215 Orleans Street
Representative in Baltimore and Sparrows Point

Savannah, Ga.
J. Gardner, 18 Broughton Street, East

New Orleans, La.
Staub News Depot, 735 Common Street

San Francisco, Cal.
Foster & Orear, Ferry Building

Seattle, Wash.
Archway Bookstore, 3rd and Pike Streets
Lowman & Hanford Company, 1st Avenue and Cherry Street

TRADE NOTES

The automatic fire alarm designed as a marine fire detection system by the Fire Detecting Wire Company, Inc., 2 West 45th street, New York, is now available for private installation. The system consists in the wiring of the hazardous parts of the ship with a continuos thermostatic wire operating on every inch of its surface. This wire is attached to indicators and fire bells on the bridge.

The Electrolytic Oxy-Hydrogen Laboratories, Inc., New York sales office, 15 William street, announces the formation of a sales and manufacturing company under the name of the Electrolabs Company. The general offices and works of both companies will be located at 2635 Penn avenue, Pittsburgh, Pa. Branch sales offices are being opened in the Morris building, Philadelphia, Pa., and the Merchants Exchange building, San Francisco, Cal.

The Keller Pneumatic Tool Company, Chicago and Grand Haven, Mich., announces the opening of the following branch offices: Birmingham, Ala., Jefferson County Bank Building, under the management of H. I. Kahn; Salt Lake City, Utah, Newhouse Building, under the management of the C. H. Jones Company; San Francisco, Cal., under the management of Eccles & Smith Company, with branch offices at Portland and Los Angeles.

W. H. Woody, division manager of the Keller Pneumatic Tool Company, Munsey Building, Washington, D. C., has been awarded a victory loan medal made from German cannon. The presentation was made by the Victory Liberty Loan Committee, Portsmoth, Va.

INTERNATIONAL

Marine Engineering

Volume XXIV NOVEMBER, 1919 Number 11

The Delay in Publication

ALTHOUGH the printers' strike in New York City, which has been at a deadlock for seven weeks, is still in force, the situation is so well in hand that no further serious delays are anticipated in the publication of future issues of MARINE ENGINEERING.

When the strike began on September 30, practically all magazine publishers whose printing was being done by union labor in New York City were forced either to suspend publication or have the printing done elsewhere. Many of the publications driven from New York in this way will not return. As a matter of fact, there is no intention on the part of the publishers to compromise with the radical element in the printing industry which is at the bottom of these labor disturbances.

Behind this outbreak can be found the same sinister influence that first in Russia, later in Germany, and now in America, is seeking to overthrow industry and establish mob rule. It is fostered by a class that violates contracts, repudiates agreements, refuses arbitration, defies its national labor organization and is a direct menace to the law and order of the land. In taking an unswerving stand against this element at whatever cost, the publishers are showing their loyalty to the United States and deserve the undivided support of their clients.



Fig. 1.—One of the Six Drydocks in the Norfolk Navy Yard

The Use of Acetylene in Navy Yards

Oxy-Acetylene Apparatus for Welding and Cutting Proves Indispensable in the Building and Repairing of Ships and Other Manufacturing Processes

BY COMMANDER H. G. KNOX, U. S. N.†

NAVY yards use acetylene very generally and in large amounts for perhaps a greater variety of purposes than do any other industrial concerns. To show that acetylene played an important part in navy yards in winning the war, the following monthly consumption of acetylene at some of the navy yards is interesting:

New York used about 110,000 cubic feet per month; Charleston, 15,000 cubic feet; Norfolk, 60,000 cubic feet; Boston, 75,000 cubic feet.

While one is apt to think of oxy-acetylene as a means of welding, it happens that in navy yards probably more acetylene is used in cutting than in welding. The war demanded of navy yards (working in many cases a 10- or 12-hour day) the reconstruction of hundreds of ships from the pursuits of peace to the transport of troops and the cargo carrying of war. Every time a passenger or cargo vessel is converted into a transport many changes are necessary. Bulkheads must be cut out or moved; ventilation must be installed; plumbing, berthing and messing fixtures must be manufactured and put in place. During the war, time was the primary consideration; money the secondary one. The acetylene torch cut its way through all obstructions and provided a quick and easily transportable means of accomplishing the desired end. Hundreds of cutters were employed day and night. Ships were converted, refitted and quickly sent on their way carrying the troops which at the vital moment perhaps turned the tide of war.

Extensive Use of Cutting Torch

Not only were ships already in existence made over,

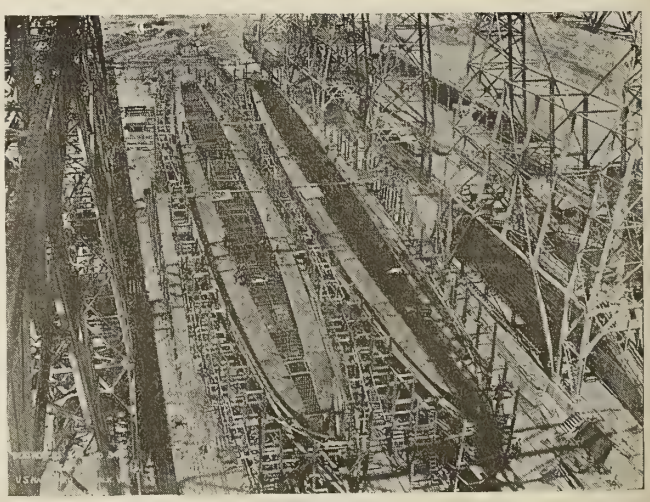


Fig. 2.—Two Destroyers in Building Slip

*Paper read at Annual Convention International Acetylene Association, New York, July 15, 1919.

†Construction Corps, United States Navy.



Fig. 3.—Structural Steel Shop at Norfolk Navy Yard

but new construction in private yards, in new shipyards and in navy yards was rushed to the limit. Practically every plate and shape involved in ship construction, both merchant and man-of-war, requires cutting to a greater or less extent to insure fitting for passage of pipes, for access doors and hatches, etc. But the portability of the gas cutting torch the tool is taken to the work rather than the work to the tool. Fig. 9 shows the heat effect around a cut.

In the field of armor cutting (and there are thousands of tons of armor in modern ships) the gas torch, of course, holds entire sway. Hydrogen here assists acetylene in the heavier cuts.

Many ingenious mechanical devices for guiding the torch have been developed, and with these a cut approaching in cleanness the cut of a power-driven tool is obtainable. On account of the cleanness of cut (Fig. 10), the gas torch is, of course, always preferred to the carbon arc.

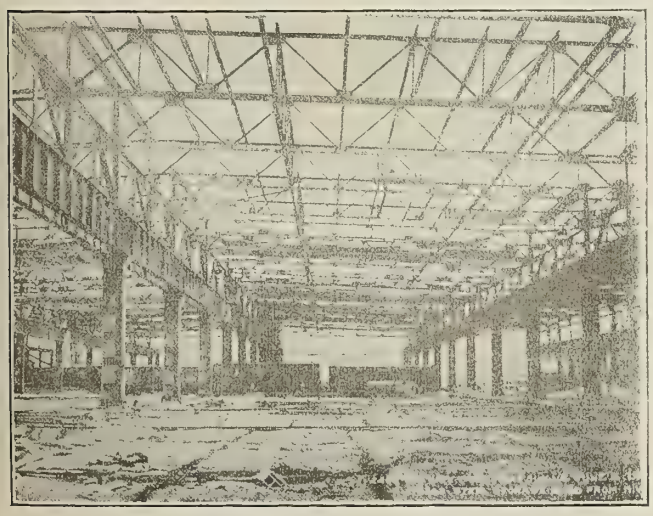


Fig. 4.—Structural Steel Storage Yard

Ship Repairs Facilitated by the Gas Torch

Not only were ships built during the war, but the navy yards were many times called upon for emergency repairs, often so extensive as to involve the rebuilding of an entire section of a ship. At New York the work on the *Texas, Huntington, Olympia* and *Æolus* would have been many weeks delayed without the gas torch. Boston did similar excellent work on the *Mount Vernon, America* and *Covington,* also in converting the *Shawmut* and *Aroostook* into mine layers. At Philadelphia the replacement of the whole forward end of a battleship which received the full impact of a mine explosion could never have been done in the required time in which it was accomplished without this fiery assistant. Boston had a like job on the torpedoed *Mount Vernon.*

When we come to the field of gas welding, navy yards do not differ, except in the variety of their work, from many of the other shops. It is only necessary to remember that every metal working trade—and that represents nearly every metal trade in extistence—at one time or another falls back on welding. The electric arc has an important place in the welding of structural steel and steel castings and forgings; but, nevertheless, acetylene is also extensively employed in this class of work. It is our belief that the gas weld responds to annealing or other heat treating much better than does the arc weld.

Anglesmith Work Now Done by Gas Arc Welder

Sea water is most unfriendly in its disposition towards steel. It therefore becomes necessary in ships to use non-corrodible metal in hundreds of places where steel or iron might otherwise be used. While the welding by electric arc of the non-ferrous alloys is undoubtedly possible and

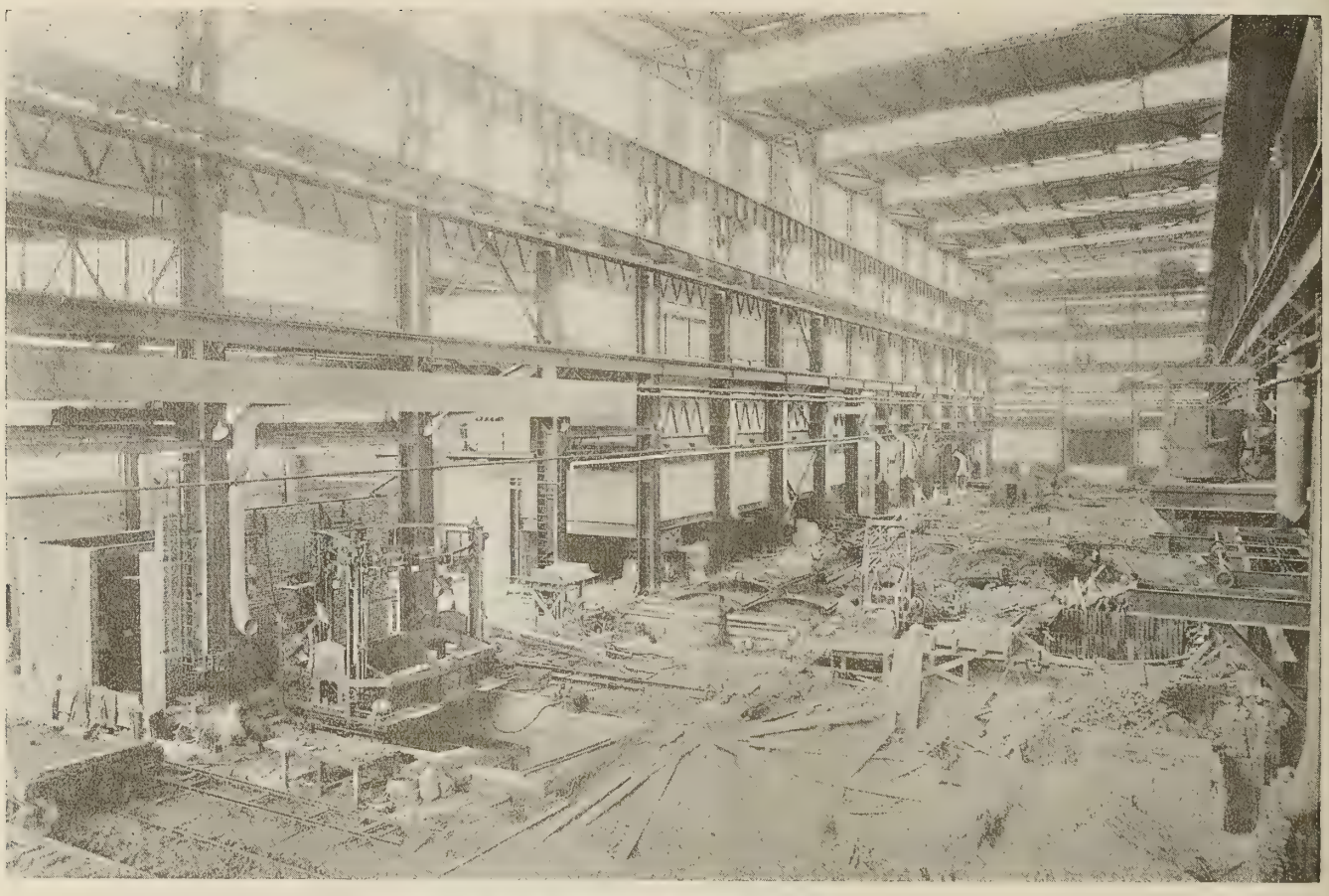


Fig. 5.—Foundry at Norfolk Navy Yard

may some day be extensively used, the use of the oxy-acetylene torch for this work up to the present has been practically universal.

The welding of angle bars (Fig. 12) and, in fact, all of the shapes used in ship construction, heretofore done by the blacksmith, is rapidly being taken over by the gas arc welder, and fittings built up out of scraps of plates, shapes, pipes, etc., are everywhere in evidence. The cost of the gas-welded article is very much less than when made by the smith. The entire drainage system, including most of the fittings of the three destroyers now being completed at Norfolk, were made by welding scraps of steel together, thereby eliminating castings. The welding of pipe (Fig. 13) and pipe fittings offers a wide field for ingenuity. Flanged elbows may be made by filling steel tubing with sand and making four close right-angle bends. When cut apart, scrap steel flanges are welded on to complete the elbows. Tees, crosses, deck and bulkhead fittings are likewise readily made up.

The brasses and bronzes used in such a variety of mixtures aboard ship (Fig. 14) are all more successfully welded or built up with the oxy-acetylene torch than by any other method. One of the most frequent callers for repairs are propellers (Fig. 15). New tips, new edges, and in some cases practically entire blades, are recast



Fig. 6.—Cutting Scrap at Norfolk Navy Yard



Fig. 7.—Cutting a 12-Inch Billet With Oxy-Acetylene Blowpipe

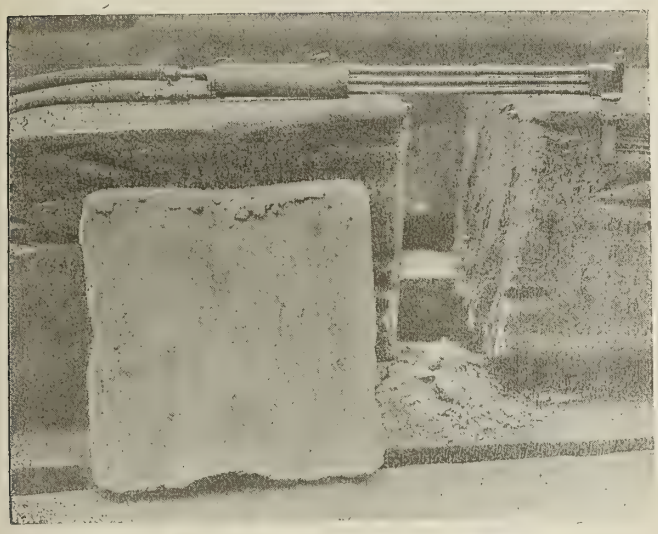


Fig. 8.—Section Cut from 12-Inch Billet

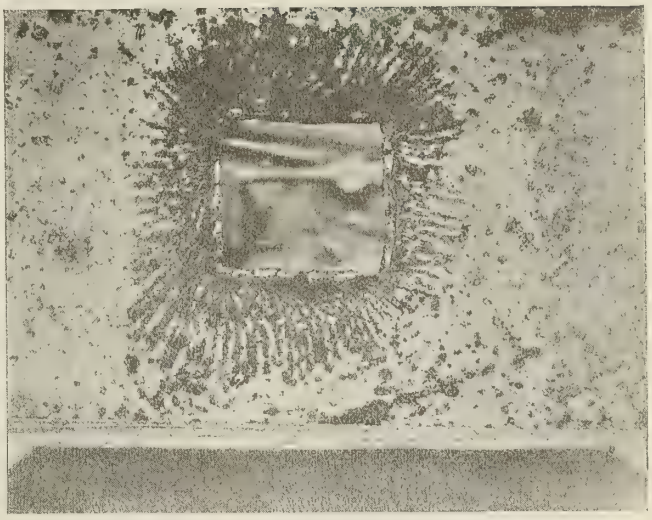


Fig. 9.—Interior Cut Made by Oxy-Acetylene Blowpipe

from manganese bronze and welded on successfully. Fittings for submarines (Fig. 16) also come in for their share of welding, and these must not only be strong but tight. Portsmouth, N. H., specializes in submarine con-

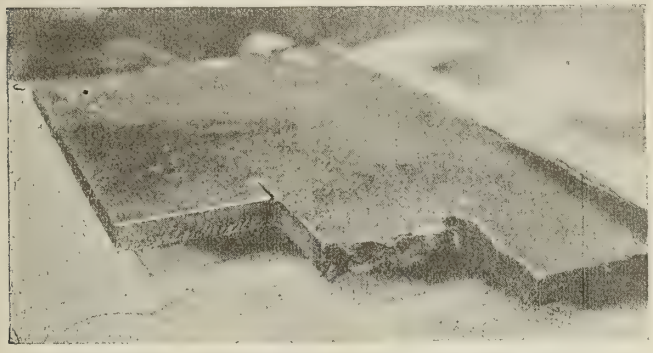


Fig. 10.—Showing Superiority of Oxy-Acetylene Cutting (at Left) Over Cutting by Carbon Arc (at Right)

struction, and frequently has to weld large manganese bronze castings for these undersea craft. Bell metal also occasionally fails, but the breaks are easily gas welded.

In addition to manganese bronze and bell metal, we also



Fig. 11.—(On Right) Watertight Door Frame Made by Welding Together Pieces of Angles and Plating. (On Left) Parts Clamped in Position Before Welding

encounter in large quantities gun metal, valve bronze, journal bronze, naval brass, muntz metal, phosphor bronze, and last, but not least, pure copper. Under intelligent operation the gas welding of copper may some day almost completely supplant the coppersmith's art of brazing. Naval rolled brass is the favorite filling material for copper and most of the other brasses and bronzes. Samples of copper pipe made up out of 5/16-inch sheet copper have been hydrostatically tested to destruction, and the welded seams compared very favorably with brazed seams.

Metals That Can Be Welded With Acetylene

Cast iron is also welded more reliably with oxy-acetylene than with the electric arc. There are times when, due to the complexity of a casting, the arc rather than gas may be more conveniently used. The use of carbon blocks

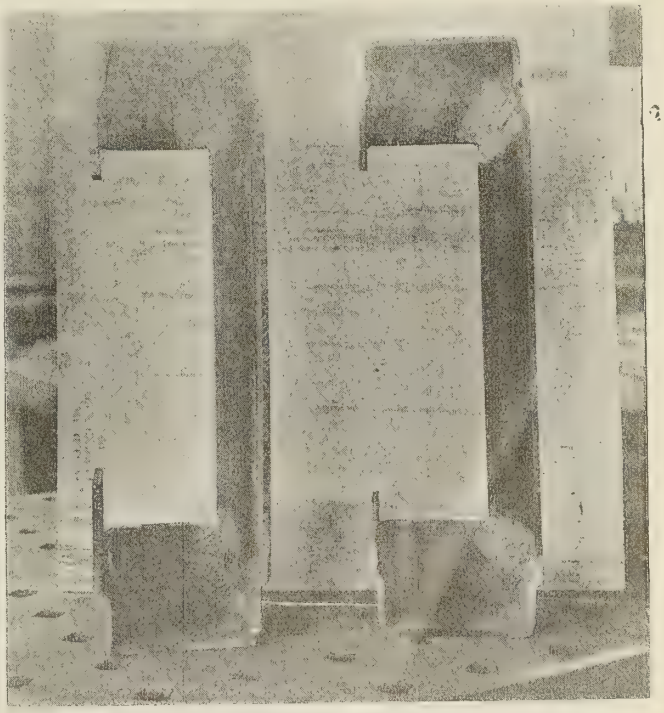


Fig. 12.—Specimen of Oxy-Acetylene Cutting and Welding as Applied to the Manufacture of Bulkhead Stapling Between Deck Beams. Joggles Made Under Hydraulic Press Where Possible

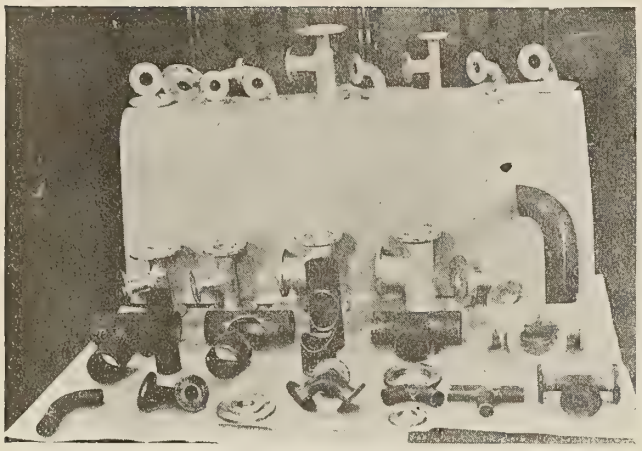


Fig. 13.—Steel Fittings Made Out of Scrap Tubing by Oxy-Acetylene Welding



Fig. 14.—Filling Shrink Holes in Manganese Bronze Propeller With Aid of Oxy-Acetylene Blowpipe



Fig. 15.—New Tip Placed on Manganese Bronze Propeller Blade by Oxy-Acetylene Process

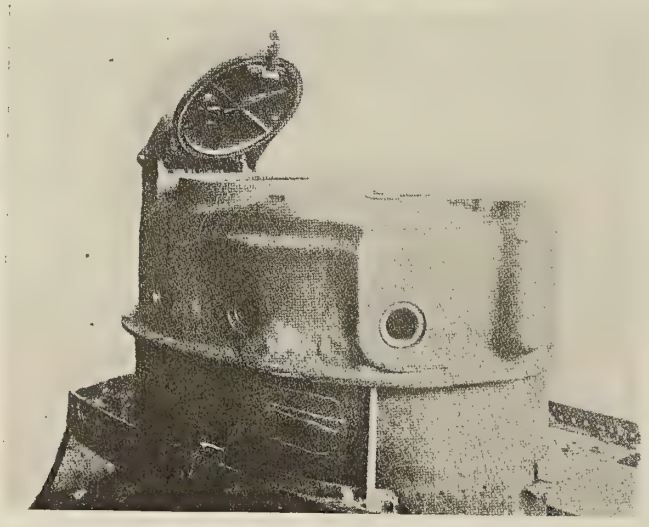


Fig. 16.—Small Holes in Manganese Bronze Casting on Submarine Oxy-Acetylene Welded. Casting Subjected to 88 Pounds Water Pressure

and carbon paste, of course, greatly extends the field of the gas torch in difficult jobs, and these aids are freely used. The preheating of a complicated iron casting is often not permissible, and a "cold" weld is more common with the arc than with gas. Gas, however, more than holds its own in the special field of cast iron.



Fig. 17.—Upper Flange of Neckar's Port First Intermediate Cylinder Welded



Fig. 18.—Starboard Low-Pressure Cylinder of the Rhein Welded

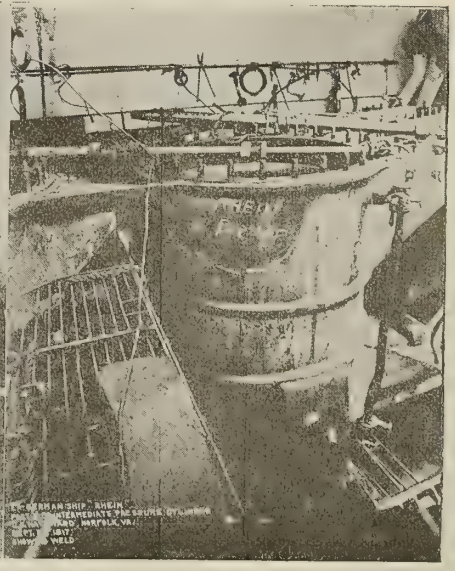


Fig. 19.—Port Second Intermediate Cylinder of the Rhein Welded

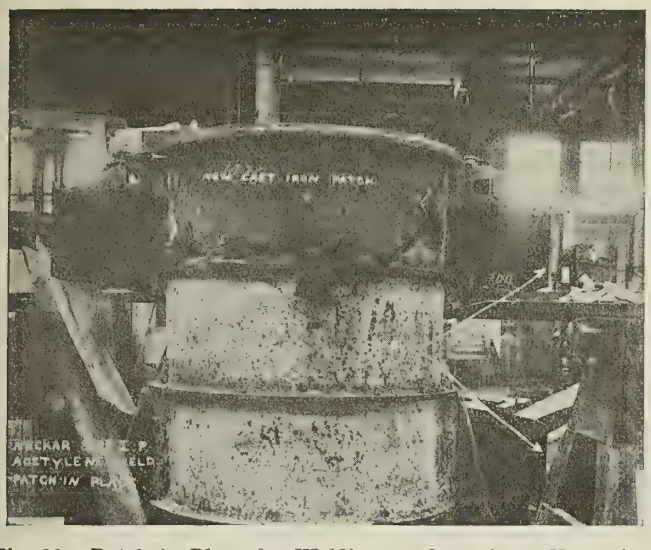


Fig. 20.—Patch in Place for Welding on One of the Neckar's Cylinders

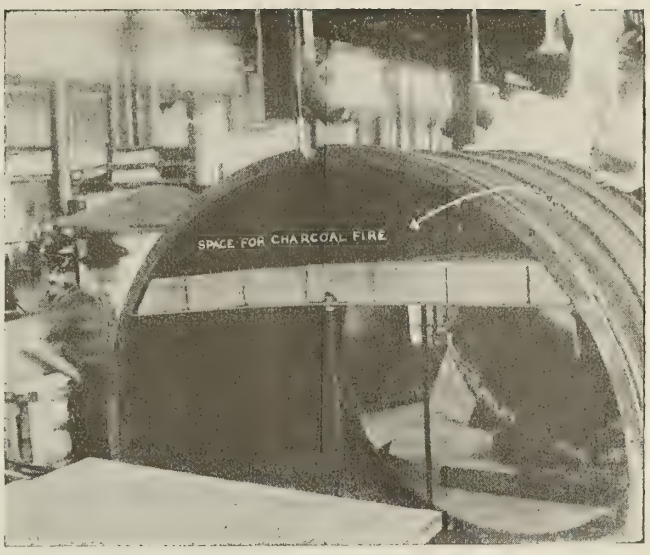


Fig. 21.—Arrangement for Preheating Liner Before Welding

Much has been said about the salvaging of the main engine cylinders of the German ships at various navy yards, particularly the New York navy yard. The repairs to engines effected by welding on those ships undoubtedly is one of the most spectacular feats of the war. At New York all of the welds were made with the electric arc, as were a few at Philadelphia, Boston and Norfolk. As far as I am aware, all of the welds made on these cylinders have stood up perfectly in service.

Damaged Engines of German Ships Repaired by Gas Welding

At Norfolk three German ships were delivered for repair—the *Rhein, Neckar* and *Bulgaria.* The major portion of the welds on the damaged cylinders of these ships were made by oxy-acetylene. The only bad break on the *Bulgaria* was repaired by electric arc. On the*Rhein* and *Neckar,* however, all of the major welds were made with gas. Six of the *Rhein's* eight cylinders were gas welded six of the *Neckar's* eight cylinders were also gas welded. (Figs. 17-19).

One important point in comparing gas and arc welds in cast iron that was brought out by the big cylinder job is the superior machining of the gas weld. A welded cylinder liner, for example, machined with no trace of hardness at the cleavage line between parent metal and filler. This was seldom the case with the arc welds where machining was required. To this extent the gas weld is superior.

Except for the size of the welds and the importance of the jobs, no special features of interest developed in the welding. Patches were made of cast iron (Fig. 20) and the patch and cylinder after clamping together were preheated with charcoal fires (Fig. 21) for several hours before welding started. In order that the puddled metal of the weld might be kept horizontal, and thereby facilitate the welding, the cylinders were carried in cradles or rockers, so that they could be rotated.

While ship work represents the principal activity of the navy yard, yet most of the navy yards carry on considerable strictly manufacturing work. A few of the yards have developed specialties in many fields.

Specialized Branches of Manufacturing

At Norfolk, for example, no less than 26,500 rectangular pipe bunks for transports were welded during the war. Nine thousand gasoline (petrol) tanks for motor boats were also turned out during the same period. The longitudinal seams of these tanks were mechanically welded on a "barrel welder." Norfolk also manufactured over 200,000 packing boxes for the Bureau of Ordnance. These airtight boxes are used for the transportation of smokeless powder from the factories where the charges are made up. The nozzles were welded to the tops of these boxes by oxy-acetylene on a piece-work basis.



Fig. 22.—Drawing Press for Making Mine Hemispheres



Fig. 23.—Welding 10-Foot Equator Seam of Mine

The biggest single war-time job of a manufacturing nature undertaken at Norfolk was the manufacture of nearly 15,000 naval defense mines (Fig. 24). Except for certain minor castings and assemblies, the work was done entirely at the navy yard. A large double-acting drawing press (Fig. 22) more than paid for itself on this job alone. Each of these mine spheres involves a 10-foot gas weld at the equator seam. Ten to twenty men were employed continuously on this work.

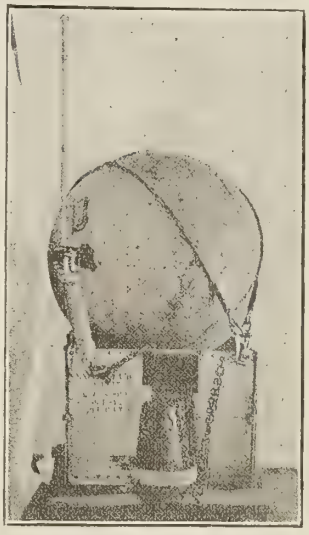


Fig. 24.—Completely Assembled Mine and Anchor

A use for acetylene in navy yards, which is out of the ordinary, is its availability for the local heating of structural plates and other members, particularly when damaged by collision. It is often necessary to straighten plates or remove bumps, and the quick local heating of such work is done, although perhaps not economically, by acetylene. During the war many vessels were fitted with underwater mine sweeping devices, and the shaping and bending of plates by acetylene for this work was quite common.

One more use for acetylene may be mentioned, although it is not general; this is lighting. Some of the navy yards during the war on more than one occasion fell back upon portable acetylene lighting equipments for their emergency work in the bottom of dry docks or other places where electric flood lamps could not readily be installed.

Most of the navy yards are equipped with their own gas generating plants. Few of the yards are, however, self-supporting, and they are therefore dependent on outside concerns for making up the deficiency.

Immediately after an unfortunate accident in the gas generating plant at Norfolk in May of this year, the writer had the privilege of visiting two or three of the largest gas plants in the country, and as a result prepared a type plan of gas generating plant for navy yard use as shown in Fig. 25. After modification in Washington and approval, it is probable that this plan will be adopted for the navy yard gas plants built in the future.

Type Plan of Gas Generating Plant

In this layout an attempt was made to separate the various gases, and in the case of acetylene the various stages of production, from generation to storage of gas in tanks. This plan also contemplates the piping of acetylene at about 12 pounds pressure to all the shops in the vicinity of the centrally located gas plant. In this way the high-pressure compression of much gas can be avoided, as well as the transportation of gas tanks. This method has already proved very efficient in many yards. Oxygen and hydrogen are likewise piped to manifolds at convenient points on the shop walls.

An innovation recently started at the Norfolk yard is the establishment of a welding shop. This does not mean that the welding shop will control or perform all welding work, but it will be the headquarters for welding and cutting equipment and trained operators. This shop will, however, do all the job welding on castings and other work removed from ships for repair. The welding shop furnishes trained men to other shops on permanent or temporary details, often in large numbers. By concentrating the work in one shop under a single foreman, it is possible to control the technique of welding better and at the same time accomplish the maximum of work with the minimum force.

Welding Shop Equipment

The equipment of this shop includes a complete gas cutting and welding outfit, as well as fixed and portable arc welding equipment. This shop furnishes all the electrode and filling material, protective devices, and, in fact, all of the adjuncts necessary to welding.

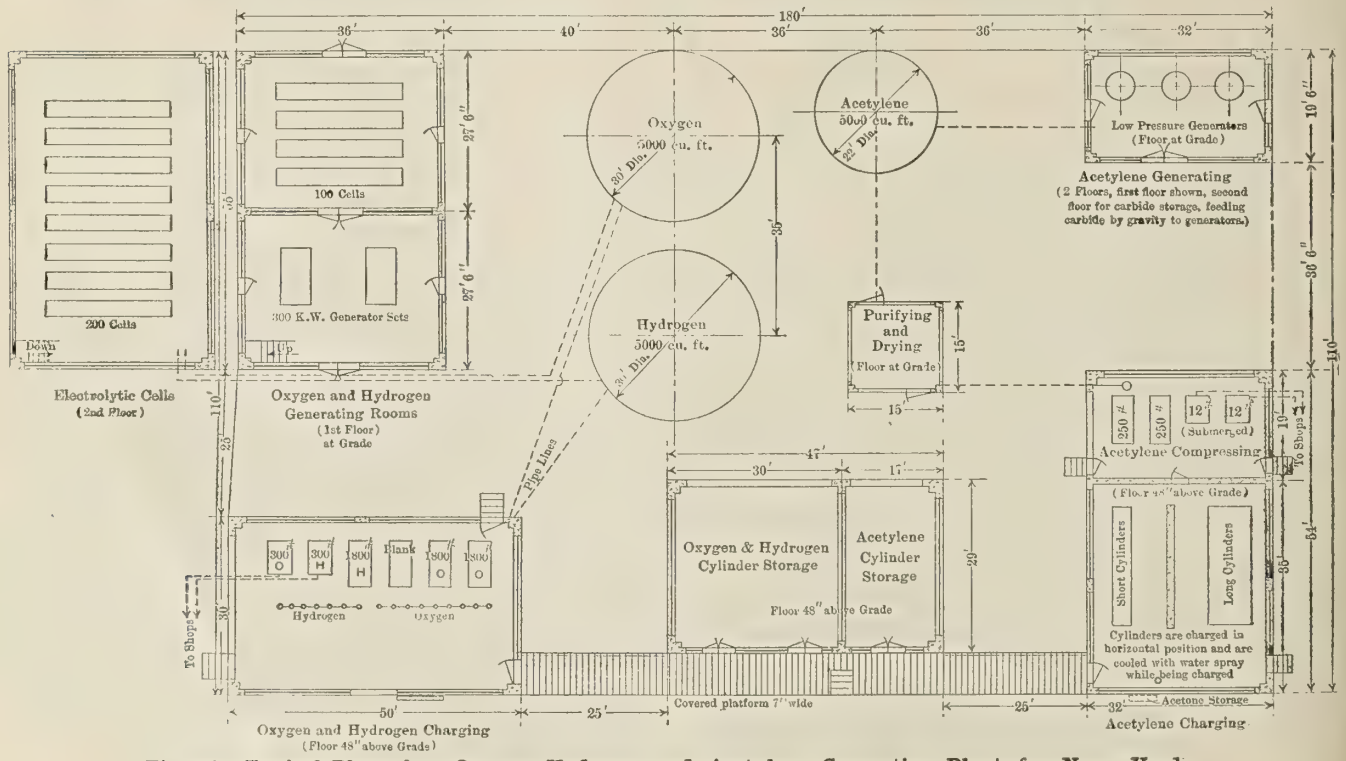


Fig. 25.—Typical Plan of an Oxygen, Hydrogen and Acetylene Generating Plant for Navy Yards

In the increase of the welding activities it became impossible during the war to obtain trained welders. At the Norfolk navy yard we therefore undertook the training of our own men, and the school now established, which works in connection with the welding shop, not only supplies our trained operators, but is also the central training point for operators from the other east coast navy yards. By giving students not only practical work but lectures on the properties of metals, the expansions and contractions encountered in welding, and kindred subjects, we endeavor to turn out students who, after they have spent a few months in practical work outside, can at any time be called upon to face the variety of problems which are, with us, an everyday occurrence.

Oxy-Acetylene Welding in Hull Construction

Parts of a Vessel Which May Be Welded With the Approval of the Principal Ship Classification Societies in the United States and Great Britain

BY CHARLES C. PHELPS*

ONE beneficial effect of the world war has been its modernizing influence on industry. American shipbuilding, in particular, has felt this influence strongly during its phenomenal growth from infancy to adultness within the interval of a few months.

One of the modern industrial aids that came to be fully appreciated in shipyards during this period was the oxy-acetylene process.



Filling Up Punched Holes in Plating by Means of an Oxy-Acetylene Blowpipe and Steel Filling Rod



Welding Butt of Door Frame With Oxy-Acetylene Blowpipe

Oxy-Acetylene Cutting Developments

Before the war the oxy-acetylene cutting process (or, as it is sometimes erroneously called, the "burning" process) had been employed very extensively in shipbuilding—in fact, it had actually revolutionized many shipbuilding operations. Perhaps it is natural that the cutting process should have been adopted initially to a greater extent than the welding process, inasmuch as it solved many difficult shipbuilding problems without introducing any new ones in its application.

Let us pause to review some of the advantages of the oxy-acetylene cutting process. It makes a clean cut and does not injure the metal in the least. It does cutting that is extremely difficult by any other method—for instance, cutting shafts, H-bars, I-beams, columns, steel castings, thick plates, and notches and inside curves in plates. The tool is brought to the work, thus eliminating much heavy lifting by cranes, with all its attendant hazards and delays, and reducing the amount of shop work. Much of the cutting is now postponed until the parts are erected on the hull framework and some is even delayed until the hull is nearing completion; this insures openings in the right places, better fitting and often contributes to the safety of operations in general. It is extremely easy to figure the savings in cost and time secured by substituting blowpipe cutting for shearing, sawing, punching and drilling.

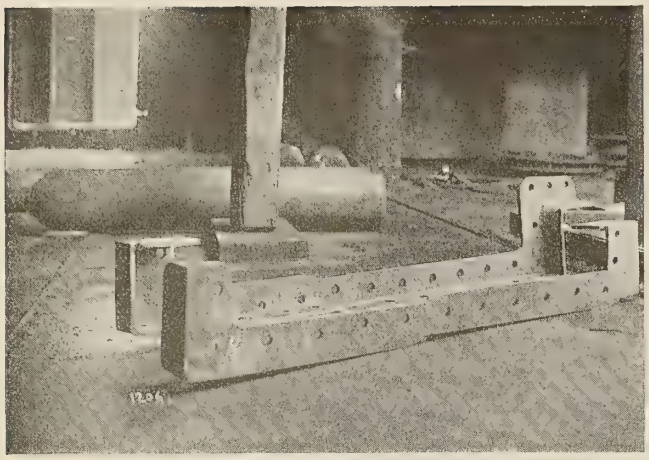
It is probable that even to-day from two-thirds to three-quarters of the acetylene force of the average shipyard is engaged in cutting work, the remainder doing principally welding work.

Value of Oxy-Acetylene Welding Appreciated by Shipbuilders

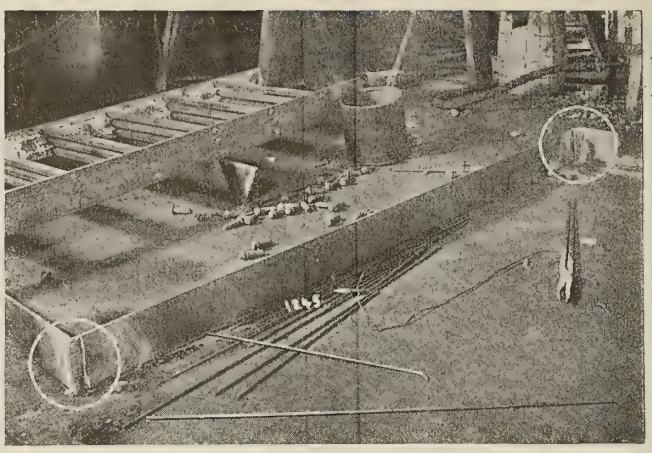
Much more oxy-acetylene welding work has been employed in ship construction in Great Britain than in the United States, due to the fact that this country is more or less young in quantity production of ships.

The development of welding in shipbuliding has been retarded in this country not only by the scarcity of trained

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Staples Made by Oxy-Acetylene Welding



Partition Base Corners Oxwelded

welders, but also by uncertainties as to ways to apply welding to specific work in order to obtain efficient results. Sometimes welding necessitates a change—usually a simplification—of the design of the parts to be joined and changes from accustomed practice always involve more or less overcoming of inertia. Experience is gradually teaching the best ways of applying welding and removing doubts as to the efficiency and economy of oxy-acetylene welded joints. Reliable tests made by various technical institutions have shown conclusively that an oxy-acetylene weld made according to present standard practice compares more than favorably with other forms of joint.

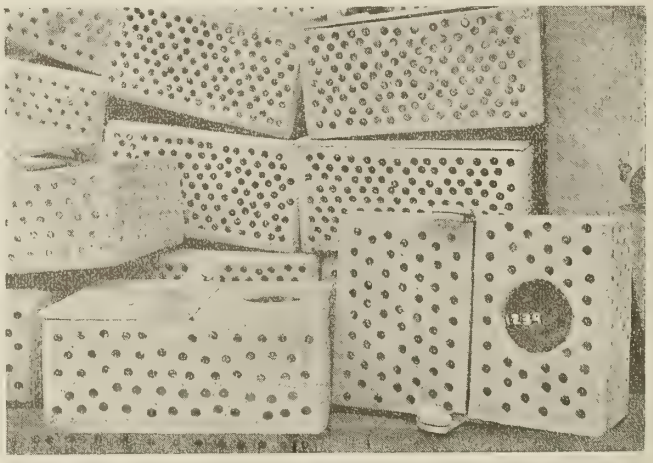
Classification Societies Approve Oxy-Acetylene Welding

With quantity production during the war the attention of shipbuilding circles was focussed on the value of oxy-acetylene welding. This fact is reflected in the recent action of such conservative bodies as Lloyd's Register of Shipping and the American Bureau of Shipping in issuing instructions to their surveyors to approve, after the hammer test, certain specific ship parts welded by the oxy-acetylene process. The surveyors of these societies had been approving a great deal of welded work for a long time, and they were still inspecting and passing, piece by piece, many parts not on the official list; but it was a step in advance when the American Bureau of Shipping took action last August by issuing the following list of parts on which oxy-acetylene welding is permitted:

Deck rail stanchions to plating.
Clips for detachable rail stanchions.
Continuous railing rods (joints).
Attaching deck collars (L rings) around ventilators.
Attaching deck collars (L rings) around smoke stacks.
Attaching cape rings around smoke stacks, pipes, etc.
Attaching galley fixtures to plating.
Attaching bath and other fixtures in officers' quarters.
Attaching cowl supporting rings to ventilators.
Bulwark rail top splicing and end fitting.
Skylights over galley.
(a) Engine room stairs and gratings.
(b) Boiler room stairs and gratings.
Attaching (a) and (b) to plating grab rods of casing.
All stairs and ladders, including rail attachments.
Door frames to casings, hinges, catches hold, coach-hooks, etc.
Clips for attaching interior wood finish to casing.
Entire screen bulkhead.
Coal chutes.
Butts of watertight and oiltight bounding bars on bulkheads or floors in double bottom.
Ventilator cowls.
Stacks and uptakes.
Bulkheads (that are not structural parts of the ship). Partition bulkheads in accommodation.
Framing and supports for engine and boiler room flooring or gratings.
Cargo batten cleats.
Tanks (that are not structural parts).
Shaft alley escapes.
Steel skylights over accommodation spaces.
Engine room skylights.
Grab rods on exterior and interior of deck houses.
Deck houses not covering unprotected openings through weather decks.
Reinforcing and protecting angles around manholes.
Joints of watertight angle collars at frames in way of watertight flats.
Joints of deck collars, reinforcing and protecting angles,



Fresh Water Tank With Rounded Corners Oxy-Acetylene Welded



Strainer Boxes Gas-Welded and Galvanized

watertight angle collars at frames in way of watertight flats, etc., and all other welds which cannot be tested satisfactorily after installation are to be welded and tested prior to installation.

Lloyd's Register of Shipping also approved the list identically as printed above on September 5, 1919.

Although the above list includes many of the more common applications, it does not begin to give an idea of the extent to which the process has been adopted in ship construction. Hundreds of other parts have been welded and have passed inspection. A few of these additional parts that are commonly welded are staples, hatch cover frames, hatch coaming corners, wash plates, crow's nest frames, davits, ash ejectors, partitions for gas-tight compartments, seams in steel masts, piping, filling up misplaced punched holes, and as a substitute for calking under certain conditions.

The welding torch is also used extensively for local heating, such as for heating the heads of rivets that have become loose so that they may be drawn up tight and for heating plates and other structural members, so that they may be shaped for a perfect fit.

Why Shipbuilders Adopt Oxy-Acetylene Welding

Whether in a given case oxy-acetylene welding should be substituted for riveting, screw-jointing, bolting, calking or a combination of these processes depends upon a consideration of the various factors involved. Welding will frequently win out on a mere comparative first cost basis, but will often make a still better showing by its reduction of maintenance expense, by producing absolute water- or oil-tightness, by avoiding the necessity of liners or packing, by eliminating gaskets and flanges in pipe work, by avoiding drilling, reaming, grinding and fitting, or by simplifying the design of interdependent parts.

In conclusion, some of the objects to which oxy-acetylene welding has been applied in other fields will be cited; these clearly indicate the reliability, efficiency and safety of the process; ammonia containers of refrigerating systems, which are subjected to extremes of temperature; compressed air receivers and compressed gas containers; Liberty motors and many airplane parts, the failure of which would endanger aviators' lives; steam pipe lines, which are subjected to extremes of temperature and pressure; poison gas containers used in chemical warfare, the failure of which would almost surely lead to disastrous consequences; marine buoys, which must resist the corrosive action of the salt water, and serve faithfully as sentinels to warn the mariner; various locomotive parts, the repair of which forms one of the most extensive applications of the process, and chemical plant installations, which involve almost all possible physical and chemical extremes.

Those who know the oxy-acetylene process best have most confidence in it. So far as the quality alone of oxy-acetylene welds is concerned, there is no reason why they should not be applied to making almost any kinds of joints, as indicated by the present broad field of application. The sole remaining questions to be decided in each case are those involving expediency and relative costs, and these cannot be settled until all the factors entering into the case are taken into consideration.

An Analysis of Stresses in Bulkhead Stiffeners
(Bracketed End Connections)

BY SPECIAL CORRESPONDENT

In a former article the stresses in clipped and free-ended bulkhead stiffeners were determined for a given bulkhead designed in accordance with the rules of one of the classification societies. It was shown that the stresses were all very high except in the case of deep tank or peak tank stiffeners.

In this article it is intended to arrive at the stresses in a corresponding set of stiffeners, if the ends are sufficiently bracketed, and also to arrive at the stresses in the rivets of the bracketed connection.

The largest factor of uncertainty in this calculation is the degree of end fixing that the bracket is capable of. Professor Hovgaard, in his classic papers on bulkhead stiffeners presented before the Society of Naval Architects and Marine Engineers some years ago, assumes that the brackets fix the ends of the stiffeners absolutely—that is, of course, if properly designed and the stresses in the stiffeners are below the elastic limit of the material. From a comparison of results obtained on tests, this assumption appears justifiable. Mr. A. Murray, in his book "Strength of Ships," assumes an end fixing coefficient for the brackets varying anywhere from 0 percent to 60 percent. His results, to the writer's knowledge, have never been compared with experimental data. In view of the practical proof of the correctness, and the sound theoretical foundation of Professor Hovgaard's figures, it is believed justifiable to accept his conclusions in their entirety. The following data, therefore, are figured on this basis.

The greatest bending moment in a stiffener fixed with a good bracket at top and bottom is, when subjected to a uniform load in foot units,

$$M = \frac{1}{12} Wl,$$

where W is the entire load carried, i. e., $W = w\,l$, where w is the load per foot and l = length in feet.

This bending moment is at the ends. The moment at the center of the stiffener would only be

$$M = \frac{1}{24} Wl;$$

that is, it is equal to half the greatest moment. Another thing to note is that this latter moment is positive, while the former is negative. The curve of bending moment changes slope very rapidly, and at points near the top and bottom the moment curve crosses the base line, and, of course, at these points is zero. Hence, if the brackets at the ends of the stiffeners are of any length at all, we find that the greatest moment the stiffener will be called upon to resist is $1/24\ Wl$. To obtain this result it is only necessary to make the depth of the brackets about 1/10 of the length of the stiffener from top to heel. This is illustrated in Fig. 1.

The introduction of the uniformly varying load due to hydrostatic pressure alters the above argument but little in regard to brackets. However, the term for the bending moments would be more involved, due to head and the varying pressure, but still for all practical purposes it

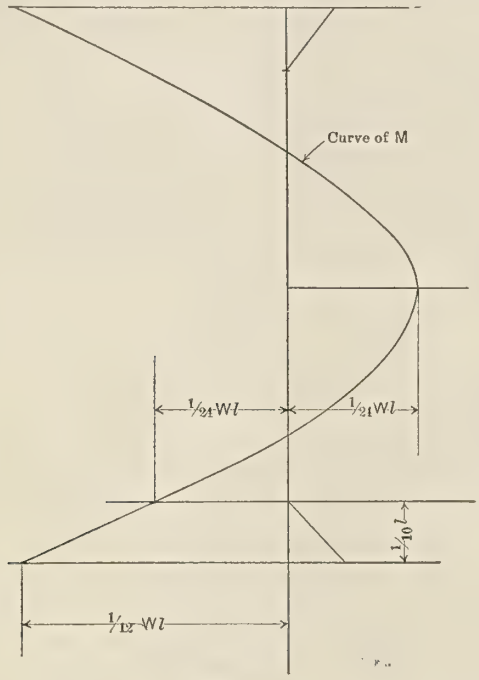


Fig. 1

would be sufficiently accurate to take this moment as $1/24\ Wl$.

A form which lends itself most readily to calculations of this character is that given by Professor Hovgaard, which is

$$M = \frac{Pl}{24} \text{ foot tons,}$$

where

$$P = \frac{s}{35}\left(h + \frac{l}{2}\right) l \text{ tons.}$$

Where, again,

P = load on stiffener in tons.
s = spacing of stiffeners in feet.
h = head of water above top of stiffeners in feet.
l = length of stiffeners in feet.

As in the former article by the author on stresses in bulkhead stiffeners, two general types of bulkheads will be considered, i. e., ordinary watertight bulkheads and deep or peak tank bulkheads. The former type is usually subdivided into cargo vessel and passenger vessel bulkheads. The stresses in these various types, as determined from the rules of one of the classification societies, will be found and discussed below.

The following data are assumed, all as shown on Fig. 2:

1. Length, heel to top, is 12 feet 0 inches.
2. Head, above top to load waterline, is 6 feet 6 inches.
3. Head, above top to bulkhead deck, is 8 feet 0 inches.
4. Spacing of stiffeners, heel to heel, is 27 inches.

The stiffener for this bulkhead, as required by the rules, is a 5½-inch by 3-inch by, 11.9-pound bulb angle.

The mean thickness of plating would be about 0.30 inch.

As in the former paper, the functional strip of plating, i. e., that portion of the bulkhead plating which acts as an integral part of the stiffener, will be taken as thirty times the thickness, or, in this case, nine inches wide.

Following the same general method of calculation as before, we find the total section modulus, i. e., stiffener and plating combined, as follows:

Name	Area, Inches	Distance of C. G. from Bulb of Angle, Inches	Moment, Inches
Plating	2.70	5.65	15.25
Stiffener	3.51	3.15	11.06
Total	6.21	4.24	26.31

Moment of inertia of plate about its own axis is $I = 1/12\ Ad^2 = 1/12 \times 2.7 \times .09 = .020$ inch units, where A is the area and d the depth of section, all in inches. And moment of inertia about the axis of the total section is $I_0 = I + Ay^2 = .020 + 2.7\ [5.65 - 4.24]^2 = .02 + 2.70 \times 1.99 = 5.39$ inch units, where A, as before, is area and y is the distance between axis, or moment of transference, all in inches.

Moment of inertia of bulb angle stiffeners about its own center of gravity is, as taken from the Carnegie handbook, 13.6 inch units, and about the new axis it would be $I_0 = I + Ay^2 = 13.6 + 3.51\ [4.24 - 3.15]^2 = 13..6 + 3.5 \times 1.19 = 17.77$ inch units. Then total moment of

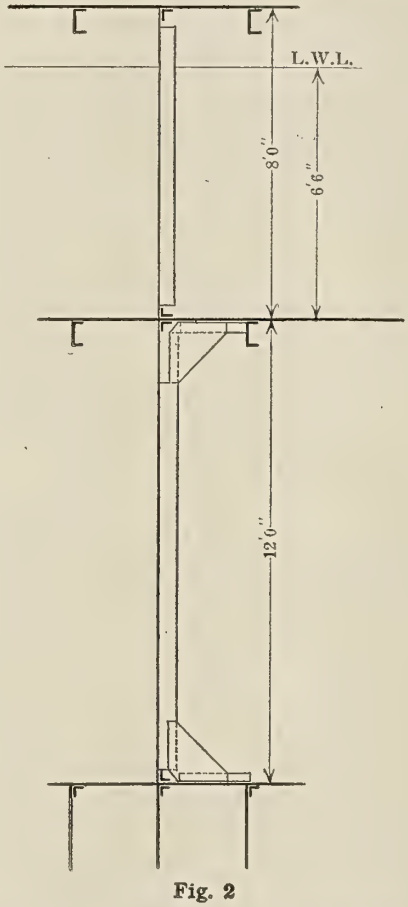


Fig. 2

inertia is $I = 17.77 + 5.39 = 23.16$ inch units, and section modulus $S = \frac{23.16}{4.24} = 5.46$ inch units.

The bending moment in this stiffener is found by the formula given before and is

$$M = \frac{Pl}{24};$$

$$P = \frac{s}{35}\left(h + \frac{l}{2}\right) l = \frac{2.25}{35}\ [6.5 + 6]\ 12 = \frac{2.25 \times 12.5 \times 12}{35} \text{ tons,}$$

and $M = \frac{2.25 \times 12.5 \times 12}{35} \times \frac{12}{24} = 4.82$ foot tons, or

$4.82 \times 12 = 57.84$ inch tons.

Having now the bending moment, the stress in the stiffener at about mid-length, or at the end of the bracket, can be found. This is

$f = \frac{M}{S} = \frac{57.84}{5.46} = 10.59$ tons per square inch, or $10.59 \times 2{,}240 = 23{,}722$ pounds per square inch.

This stress, it is seen, is moderate and within the limits laid down in the previous article, but the true conditions cannot be arrived at before the strength of the end connections has been investigated.

If the vessel under consideration is a passenger vessel the usual practice would be to slightly increase the size of the stiffener. In this particular case it would be increased to a 6-inch by 3-inch by 12.4-pound bulb angle.

The section modulus is, in this case, figured in detail as follows:

Name	Area, Inches	Distance from Bulb of Angle, Inches	Moment, Inches
Plating	2.70	6.15	16.61
Stiffener	3.62	3.29	11.91
Total	6.32	4.51	28.52

The moment of inertia of the plate is, as before, .020 inch units, but now $I_0 = .02 + 2.70\ [6.15 - 4.51]^2 = .02 + 2.70 \times 2.69 = 7.27$ inch units.

The moment of inertia of the bulb angle, from Carnegie's handbook, is 18.6 inch units and $I_0 = 18.6 + 3.62\ [4.51 - 3.29]^2 = 18.6 + 3.62 \times 1.49 = 23.99$ inch units.

Then the total moment of inertia is $I = 23.99 + 7.27 = 31.26$ inch units, and section modulus $S = \frac{31.26}{4.51} = 6.93$ inch units.

The bending moment, of course, is as before, and hence the stress in the stiffener is

$f = \frac{57.84}{6.93} = 8.35$ tons per square inch $= 8.35 \times 2{,}240 = 18{,}704$ pounds per square inch.

This stress is most moderate, but, as before, we must investigate the end connections before we can be sure that the stress will be held to so conservative a figure as above.

As pointed out in the previous article, the functional strip of plating is of great importance, and it is found that it reduces the stress in the stiffeners a considerable amount. For example, in the above two cases if the functional plating is omitted in the calculation the stress would be, taking section modulae of bulb angles as given in Carnegie's handbook,

$$f = \frac{57.84}{4.3} = 13.45 \text{ tons per square inch.}$$

instead of 10.59 tons per square inch in the first case, and $f = 10.15$, instead of 8.35 tons per square inch in the second case. The above figures bring out very clearly the importance of good sound rivets between the plating and stiffeners.

The next type of bulkhead to be considered is that forming the boundary of a deep ballast or peak tank. For comparison between stresses, the same figures as shown on sketch 2 have been taken for this case also.

The stiffener required by the rules for this bulkhead would be a 7½-inch by 3-inch by 16.3-pound bulb angle, and if the spacing remains the same the plating will be increased to about .34 inch thick.

The section modulus is then found as below:

Name	Area, Inches	Distance from Bulb of Angle, Inches	Moment, Inches
Plate	8.47	7.67	64.86
Stiffener	4.80	4.08	19.58
Total	13.27	6.36	84 44

I of plate $= 1/12\ Ad^2 = 1/12 \times 8.47 \times .34 + .34 = .081$ inch units, and $I_0 = .081 + 8.47\ [7.67 - 6.36]^2 = .081 + 8.47 \times 1.72 = 15.38$ inch units.

Moment of inertia of stiffener about its own axis is, from Carnegie's handbook, 34.4 inch units, and $I_0 = 34.4 + 4.80\ [6.36 - 4.08]^2 = 34.4 + 4.80 \times 5.20 = 59.36$ inch units. Total moment of inertia is $I = 59.36 + 15.38 = 74.74$ inch units.

The section modulus is $S = \frac{74.74}{6.36} = 11.75$ inch units, and, since the bending moment is unchanged, the stress

$f = \frac{57.84}{11.75} = 4.92$ tons per square inch $= 4.92 \times 2{,}240 = 11{,}021$ pounds per square inch.

This stress is very moderate, but, as before, the end connections are the vital point.

A point in connection with these deep tank stiffeners; a ballast tank is usually not carried full except when the vessel is in the light condition. This would result in a material reduction in the static head and a consequent reduction in stress in the stiffener.

Suppose in the case before us, due to the vessel being in ballast condition, that the head is only to the tank top. The bending moment then is, using same notations,

$$M = \frac{1}{24} Pl.$$

$$P = \frac{3}{35}\left(h + \frac{l}{2}\right) l = \frac{2.25}{35}(o + 6)\ 12 = \frac{2.25 \times 72}{35}$$

Then

$$M = \frac{2.25 \times 72 \times 12}{24 \times 35} = 2.314 \text{ foot tons} = 27.77 \text{ inch tons}$$

The stress, then, in the stiffener will be

$f = \frac{27.77}{11.75} = 2.36$ tons per square inch, or 5,286 pounds per square inch.

As before, suppose the functional strip of plating is omitted. This will cause, of course, an increase in stress, which is, in the full pressure condition, from 4.92 to $\frac{57.84}{8.5}$, or 6.80, tons per square inch. As before, this is a large percentage of increase.

Before taking up the stresses in the bracket rivets, I would like to point out that, while we have designed the first two types of bulkheads for a head up to the load waterline, they will, if called upon in case of accident, have to withstand a greater pressure. When a compartment is flooded, due to collision, the vessel will sink a certain amount because of lost buoyancy. If the vessel is of a design to float with a compartment open to the sea, the maximum draft under this condition would be a little below the bulkhead deck, and hence the bulkhead adjoining this flooded compartment will be subjected to

this increased head and must withstand it to keep the vessel afloat. In the present case, under these conditions, the bending moment will be

$$M = \frac{1}{24} Pl,$$

as before, but P is increased to

$$\frac{2.25}{35}(8 + 6)\ 12 = \frac{2.25 \times 14 \times 12}{35},$$

which makes

$$M = \frac{2.25 \times 14 \times 12 \times 12}{24 \times 35} = 5.40 \text{ foot tons, or } 64.8 \text{ inch tons.}$$

The stresses resulting from this increased moment are, for the cargo vessel bulkhead,

$$f = \frac{64.8}{5.46} = 11.87 \text{ tons per square inch,}$$

and for the passenger vessel bulkhead,

$$f = \frac{64.8}{6.93} = 9.06 \text{ tons per square inch,}$$

and for the deep tank bulkhead,

$$f = \frac{64.8}{11.75} = 5.52 \text{ tons per square inch.}$$

All the above stresses are still within the yield point of the material, so as far as they themselves are concerned the vessel would still be seaworthy.

To investigate the strength of the end connections, it is necessary to determine the bending moment at the ends

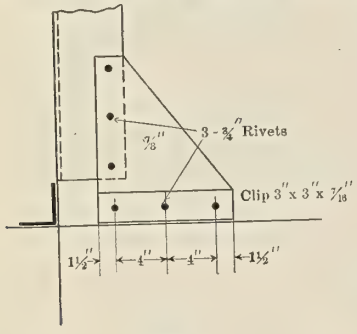


Fig. 3

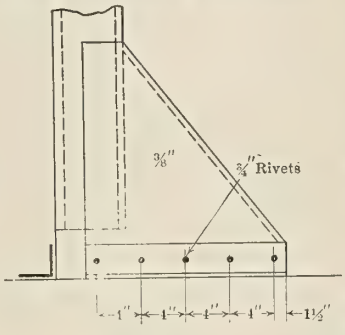


Fig. 4

and equating this to the section modulus of the riveting we can find the stress in these rivets due to the bending. With this stress, however, the shear stress due to supporting forces must be combined, giving the actual shear in the rivets making up this connection.

A fixed beam, as stated before, has its greatest bending moment at the fixed ends, and this is in this case about twice that found at the middle length above. Due to hydrostatic pressure, the end bending moment and end supporting force is greatest at the bottom, and, since it is usual practice to put the same number of rivets in the top and bottom bracket, we will here only consider the stresses in the bottom connection.

The bending moment at the bottom end of the stiffener is (using Professor Hovgaard's notation) given by the expression $M = .092\ Pl$. This includes, besides the 1/24 Pl before discussed, the additional bending moment due to hydrostatic pressure.

Since the head is taken, as before, to the load waterline, P will be as found above and give

$$M = .092 \times 12 \times \frac{2.25 \times 12.5 \times 12}{35} = 9.27 \text{ foot tons, or}$$

111.24 inch tons.

The usual connection for the bracket of the 5½-inch bulb angle stiffener would be three ¾-inch rivets. The disposition would be about as shown in the sketch Fig. 3. The polar moment of inertia of these rivets, assuming that the holes were 13/16-inch diameter, and, consequently, also the driven rivets, would be $I_p = 2 \times 4^2 \times .519 = 16.61$ inch units, and the section modulus would be

$$s = \frac{16.61}{4} = 4.17 \text{ inch units.}$$

This would give the stress in these rivets, due to bending alone, as

$$P = \frac{M}{s} = \frac{111.24}{4.17} = 26.7 \text{ tons per square inch.}$$

This in itself is far too high and is not at all in proportion to the stress in the stiffener itself.

To find the shear due to direct load, it is first necessary to find the supporting force at the bottom. This force is given by the following equation:

$$P_b = \frac{whls}{2} + \frac{7}{20} wl^2 s \text{ pounds,}$$

where w = weight of water per cubic foot.
h = head in feet.
l = length of stiffener in feet.
s = spacing of stiffeners in feet.

$$P_b = \frac{64 \times 6.5 \times 12 \times 2.25}{2} + \frac{7 \times 64 \times 144 \times 2.25}{20} =$$

5,616 + 7,258 = 12,874 pounds, or 5.75 tons.

From this reaction the shear in rivets is

$$q = \frac{5.75}{3 \times .519} = 3.69 \text{ tons per square inch.}$$

These two stresses when combined give the total shear on the rivets, which is

$$f = \sqrt{q^2 + P^2} = \sqrt{3.69^2 + 26.7^2} = \sqrt{726.51} = \text{about } 26.95 \text{ tons per square inch.}$$

This is true only for the outer rivet of the bottom connection, but is the maximum stress. Since the ultimate shearing strength of mild rivet material is only 22.5 tons per square inch, it is seen that this connection is too weak, and that in this case we cannot maintain the stress found in the stiffener on the assumption that the ends are fixed, but, rather, that this stress will be largely increased.

The connection for the 6-inch bulb angle would be the same as for the 5½-inch bulb and the figures above would hold for both cases.

If it is decided to put four ¾-inch rivets in this connection, the stresses would be reduced and are found below. The rivets will still be 4 inches center to center, and hence

$$I_p = 2 \times 2^2 \times .519 + 2 \times 6^2 \times .519 = 4.15 + 37.37 = 41.42 \text{ inch units,}$$

and

$$s = \frac{41.42}{6.0} = 6.91 \text{ inch units.}$$

Then

$$P = \frac{111.24}{6.91} = 16.09 \text{ tons per square inch,}$$

and

$$q = \frac{5.75}{4 \times .519} = 2.76 \text{ tons per square inch.}$$

This gives

$$f = \sqrt{2.76^2 + 16.09^2} = \sqrt{263.91} = \text{about } 16.25 \text{ tons per square inch.}$$

This stress is still too high and not comparable to the stress in the stiffener itself.

Five ¾-inch rivets would not be out of reason for this stiffener. This would give stresses as follows, taking the riveting as shown in the sketch (Fig. 4):

$$I_p = 2 \times 8^2 \times .519 + 2 \times 4^2 \times .519 = 66.43 + 16.61 = 83.04 \text{ inch units.}$$

$$s = \frac{83.04}{8.0} = 10.38 \text{ inch units.}$$

This gives

$$P = \frac{111.24}{10.38} = 10.72 \text{ tons per square inch,}$$

and

$$q = \frac{5.75}{5 \times .519} = 2.21 \text{ tons per square inch,}$$

which gives

$$f = \sqrt{2.21^2 + 10.72^2} = \sqrt{119.80} = \text{about } 10.93 \text{ tons per square inch.}$$

This stress is about right and compares well with the stress in the stiffeners.

For the 6-inch stiffener the five rivets as above give a satisfactory result and are not very much greater than the stress in the stiffener.

In the case of the 7½-inch bulb stiffener on the tank bulkheads the classification societies would require at least five ¾-inch rivets. If this is done the stress in the rivets will be the same as found immediately above. Five rivets for this size bulb angle is rather scant, and six would give us a stress more nearly equal to that in the stiffener. As-

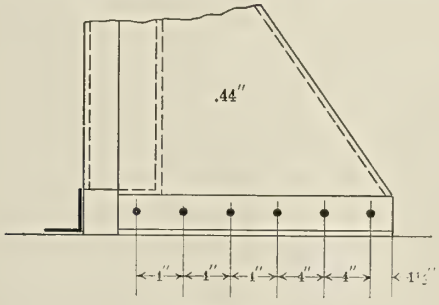


Fig. 5

suming six are fitted, the stress would work out as below, taking the rivets as indicated in the sketch (Fig. 5):

$$I_p = 2 \times 2^2 \times .519 + 2 \times 6^2 \times .519 + 2 \times 10^2 \times .519 = 4.15 + 37.37 + 103.80 = 145.32 \text{ inch units,}$$

and

$$s = \frac{145.32}{10.0} = 14.53 \text{ inch units.}$$

This gives

$$P = \frac{111.24}{14.53} = 7.67 \text{ tons per square inch,}$$

and

$$q = \frac{5.75}{6 \times .519} = 1.85 \text{ tons per square inch,}$$

Hence,

$$f = \sqrt{1.85^2 + 7.67^2} = \sqrt{62.25} \quad \text{about } 7.89 \text{ tons per square inch.}$$

This stress, while moderate, is still not nearly equal to the stress in the stiffener itself. In view of this it might in this case be allowable to increase the size of rivets to ⅞-inch in diameter. To keep the size of the bracket down, it would be permissible to retain the pitch of rivets at four inches. Assume holes punched 15/16-inch diameter. This would then be the size of the driven rivets. The moment of inertia would vary exactly as the area of the rivet, as also would the section modulus, and hence the stresses would vary inversely as the area. Following this line of reasoning the final stress in the rivets would be

$$f = 7.89 \times \frac{.519}{.690} = 5.82 \text{ tons per square inch.}$$

This stress compares very favorably with that obtained for the stiffener itself in the early part of this paper.

In conclusion, it is intended to find the stress in the rivets when the stiffeners are subjected to the maximum head—that is, when the vessel has sunk to a draft nearly level with the bulkhead deck.

The bending moment at the bottom is, in this case,

$$M = .092\ Pl,$$

and

$$P = \frac{s}{35}\left(h + \frac{l}{2}\right) l = \frac{2.25}{35}(8 + 6)\ 12 = \frac{2.25 \times 14 \times 12}{35}.$$

Hence,

$$M = \frac{2.25 \times 14 \times 12 \times .092 \times 12}{35} = 11.92 \text{ foot tons.}$$

Also, the supporting force at the bottom is found as before:

$$P_b = \frac{whls}{2} + \frac{7wl^2s}{20} \text{ pounds} = \frac{64 \times 8 \times 12 \times 2.25}{2} + \frac{7 \times 64 \times 144 \times 2.25}{20} = 6{,}912 + 7{,}258 = 14{,}170 \text{ pounds,}$$

or 6.32 tons

With these forces and the section modulus of the riveting previously found, we can obtain the stresses for the three-rivet, four-rivet, five-rivet and six-rivet connections, respectively.

For the three ¾-inch rivets,

$$P = \frac{11.92 \times 12}{4.17} = 34.06 \text{ tons per square inch.}$$

$$q = \frac{6.32}{3 \times .519} = 4.06 \text{ tons per square inch.}$$

$$f = \sqrt{4.06^2 + 34.06^2} = \sqrt{1{,}176.57} = \text{about } 34.30 \text{ tons per square inch.}$$

For the four ¾-inch rivets,

$$P = \frac{11.92 \times 12}{6.91} = 20.55 \text{ tons per square inch.}$$

$$q = \frac{6.32}{4 \times .519} = 3.04 \text{ tons per square inch.}$$

$$f = \sqrt{3.04^2 + 20.55^2} = \sqrt{431.54} = \text{about } 20.75 \text{ tons per square inch.}$$

For the five ¾-inch rivets,

$$P = \frac{11.92 \times 12}{10.38} = 13.68 \text{ tons per square inch.}$$

$$q = \frac{6.32}{5 \times .519} = 2.43 \text{ tons per square inch.}$$

$$f = \sqrt{2.43^2 + 13.68^2} = \sqrt{193\ 05} = \text{about } 13.88 \text{ tons per square inch.}$$

For the six ¾-inch rivets,

$$P = \frac{11.92 \times 12}{14.53} = 9.84 \text{ tons per square inch.}$$

$$q = \frac{6.32}{6 \times .519} = 2.03 \text{ tons per square inch.}$$

$$f = \sqrt{2.03^2 + 9.84^2} = \sqrt{100.95} = \text{about } 10.04 \text{ tons per square inch.}$$

For the six 7/8-inch rivets,

$$f = 10.04 \times \frac{.519}{.690} = \text{about } 7.55 \text{ tons per square inch.}$$

In order to clarify the results of the above calculations and to make a discussion of the figures easier, they are gathered together and arranged in the form of a table, which is given below.

RECAPITULATION OF STRESSES IN BRACKETED BULKHEAD STIFFENERS

Nature of Stress	Ordinary Cargo Bulkheads: Head to Load Water Line	Ordinary Cargo Bulkheads: Head to Bulkhead Deck	Passenger Vessel Bulkheads: Head to Load Water Line	Passenger Vessel Bulkheads: Head to Bulkhead Deck	Ballast and Peak Tank Bulkheads: Head to Load Water Line	Ballast and Peak Tank Bulkheads: Head to Bulkhead Deck
Bending moment at mid-length	4.82 Ft/Tons	5.40 Ft/Tons	4.82 Ft/Tons	5.40 Ft/Tons	4.82 Ft/Tons	5.40 Ft/Tons
Stress at extreme fibre at mid-length	10.59 Ts/□″	11.87 Ts/□″	8.35 Ts/□″	9.06 Ts/□″	4.92 Ts/□″	5.52 Ts/□″
Stress at extreme fibre without plating	13.45 Ts/□″		10.15 Ts/□″			
Bending moment at bottom	9.27 Ft/Tons	11.92 Ft/Tons	9.27 Ft/Tons	11.92 Ft/Tons	9.27 Ft/Tons	11.92 Ft/Tons
Reaction at bottom	5.75 Tons	6.32 Tons	5.75 Tons	6.32 Tons	5.75 Tons	6.32 Tons
Stress in rivets due to bending—						
Three ¾-inch rivets	26.70 Ts/□″	34.06 Ts/□″	26.70 Ts/□″	34.06 Ts/□″	26.70 Ts/□″	34.06 Ts/□″
Four ¾-inch rivets	16.09 Ts/□″	16.09 Ts/□″	16.09 Ts/□″	16.09 Ts/□″	16.09 Ts/□″	16.09 Ts/□″
Five ¾-inch rivets	10.72 Ts/□″	13.68 Ts/□″	10.72 Ts/□″	13.68 Ts/□″	10.72 Ts/□″	13.68 Ts/□″
Six ¾-inch rivets	7.67 Ts/□″	9.84 Ts/□″	7.67 Ts/□″	9.84 Ts/□″	7.67 Ts/□″	9.84 Ts/□″
Six 7/8-inch rivets						
Stress in rivets due to bottom reaction—						
Three ¾-inch rivets	3.69 Ts/□″	4.06 Ts/□″	3.69 Ts/□″	4.06 Ts/□″	3.69 Ts/□″	4.06 Ts/□″
Four ¾-inch rivets	2.76 Ts/□″	3.04 Ts/□″	2.76 Ts/□″	3.04 Ts/□″	2.76 Ts/□″	3.04 Ts/□″
Five ¾-inch rivets	2.21 Ts/□″	2.43 Ts/□″	2.21 Ts/□″	2.43 Ts/□″	2.21 Ts/□″	2.43 Ts/□″
Six ¾-inch rivets	1.85 Ts/□″	2.03 Ts/□″	1.85 Ts/□″	2.03 Ts/□″	1.85 Ts/□″	2.03 Ts/□″
Six 7/8-inch rivets						
Total shear in rivets—						
Three ¾-inch rivets	26.95 Ts/□″	34.30 Ts/□″	26.95 Ts/□″	34.30 Ts/□″	26.95 Ts/□″	34.30 Ts/□″
Four ¾-inch rivets	16.65 Ts/□″	20.75 Ts/□″	16.65 Ts/□″	20.75 Ts/□″	16.65 Ts/□″	20.75 Ts/□″
Five ¾-inch rivets	10.93 Ts/□″	13.88 Ts/□″	10.93 Ts/□″	13.88 Ts/□″	10.93 Ts/□″	13.88 Ts/□″
Six ¾-inch rivets	7.89 Ts/□″	10.04 Ts/□″	7.89 Ts/□″	10.04 Ts/□″	7.89 Ts/□″	10.04 Ts/□″
Six 7/8-inch rivets	5.82 Ts/□″	7.55 Ts/□″	5.82 Ts/□″	7.55 Ts/□″	5.82 Ts/□″	7.55 Ts/□″

Ultimate strength of mild steel shapes, 28 to 33 tons per square inch.
Elastic limit of mild steel shapes, 18 to 20 tons per square inch.
Ultimate shear strength of mild steel rivets, 21 to 24 tons per square inch.
Maximum allowable stress in shapes should be $\frac{30}{2} = 15$ tons per square inch.
Maximum allowable shear in rivets should be $\frac{22.5}{2} = 11.25$ tons per square inch.
Suggested working stress in shapes, 10 tons per square inch.
Suggested working stress in rivets, 8 tons per square inch.

The figures in the table speak for themselves in showing that there has not been enough investigation into the riveting of brackets. The riveting as called for by the rules of the various classification societies appears too light.

In the former article on free-ended stiffeners greater stresses in the stiffeners themselves were found than in the above analysis, and this fact may tend to explain the high stresses found in the bracket rivets. That is, if the stresses in both types of stiffeners were taken to be the same, we would be led to the conclusion that the brackets were not intended to fix the ends of the stiffeners absolutely, but rather only partially so. This reasoning would lead to Mr. A. Murray's method of figuring stresses mentioned in the early part of this paper. It appears to the author that if this is the case it is the wrong method of design and should be abandoned, and instead an attempt should be made actually to fix the ends of the stiffeners or otherwise consider them free-ended. Any halfway design involves dangers of failure because the true stresses cannot be obtained by mathematics. In any case, to fix the ends means only the addition of one or two rivets with bracket over that required by the registration societies, and the gains involved justify this.

Another point to be considered is the question of induced stresses. Often bulkhead bracket clips are connected to comparatively weak or non-rigid parts of the hull structure. Any deflection, of course, in the member to which the brackets are secured means the loss of all the fixing power of the brackets. In all but the smallest bulkheads this point must be watched and local reinforcements or doubling may be desired at the deck and tank top. It should be borne in mind that giving of the bracket usually means failure of the bulkhead, since the size of stiffener associated with brackets is not large enough to stand up after the support of a bracket has been removed due to local deflection or some such other cause.

A point which should be made at this time is that practically it will be next to impossible to absolutely fix and hold the ends of the stiffeners. This is due to the nature of the construction. A riveted connection will most always slip when subjected to a stress of any magnitude, and the instant that this stretch occurs the stiffener is no longer fixed. While the stress in the connection is still reasonable, the stiffener will act as a partially fixed beam, but no method can be given for determining the percentage of fixation and the resulting stress in the stiffener cannot be figured, although, of course, it is known that it will be between the limits of the fixed and free-ended conditions. If the stress is large, for example, as found above for the condition of three riveted bracket connections, the slip or stretch in the connection will be sufficiently great to destroy entirely the end-fixing properties of the brackets, and the stiffeners will then act as freely supported beams and, of course, fail. These conditions should be understood and guarded against.

The above discussion will show that it is impossible actually to predict the stresses in the rivets and brackets and also why it is important to provide ample riveting and strength in the brackets. Where it is possible to fit rigid brackets, the stiffeners should be designed as being free-ended. If desired, light brackets may be installed and the stresses in this case may be increased about 15 to 20 percent in the stiffener in consideration of the part end-fixing brackets, but in no case must the permissible stress exceed the yield point of the material.

In conclusion, it is hoped that the above figures and those contained in the former article will lead to more careful bulkhead design. When a bulkhead is put into a vessel to keep her afloat, we should know with certainty that it will perform its function. A weak bulkhead, like any other structure which is too weak, is just so much material and labor thrown away, and this local weakness may, by failing at a critical time, cause the loss of considerable more material and labor, to say nothing of the lives involved.



Fig. 1.—At the Docks of the United States Steel Corporation, Conneaut, Ohio, Seven Unloaders Are in Operation. Four Are Shown in the Illustration

Automatic Ore Unloaders on the Great Lakes

Two Operators Control Unloading, Weighing and Delivery of Ore from Ship's Hold to Car or Storage Pile

THE equipment provided for handling ore shipments on the Great Lakes is representative of the highly specialized facilities which can be developed to reduce handling costs. Units of seven and eight of these automatic ore unloaders are installed at Ashtabula and Conneaut. At the latter port, 76,000 tons of ore are unloaded by 15-ton buckets in twenty-four hours.

The unloader consists of a main framework mounted on trucks which travel along runway rails, as shown in the accompanying illustrations. This framework extends back to the rear runway over a temporary storage pile where the ore can be discharged if desired. Underneath the space between the front and rear runways, railroad tracks are built where ore-carrying cars can be placed under the machines and loaded with ore for transportation to the furnace plants. The girders of the main framework form a support for auxiliary runway rails, on which a trolley travels. The trolley supports a balanced walking beam, from the outer end of which a stiff bucket leg depends. The attached bucket is operated by machinery located in the enclosed house on the walking beam—horizontal movements by means of moving the trolley backwards and forwards on the girders, and vertical movements by the operation of the walking beam. The forward portion of the beam being out of balance, the bucket descends by gravity as soon as the brakes of the hoisting mechanism are released.

The bucket shells are each made of a single piece of plate formed to the shape illustrated. These bucket shells are usually provided with manganese steel-cutting lips to resist the abrasive action of the ore. Fig. 4 shows the bucket in operation in the hold of a modern ore carrier after most of the ore has been removed and the balance has been scraped into position so that it can be handled by the bucket.

A receiving hopper located at the forward end of the main framework, between the main girders, is provided for the purpose of receiving the ore discharged from the bucket. The capacity of this hopper is about three full bucket loads. The hopper serves as a balancing point for the ore between the bucket and the cars or storage, as the case may be. The bottom of the hopper is provided with outlet gates through which the con-

> On the Great Lakes American freighters manned by high-wage crews carry ore, grain and coal one thousand miles for fifty cents (2/1) a ton, and make a profit. Where an ocean vessel may operate all the year round, the lake freighter has a season of only eight months. No ocean rate in the world is so low as that for carrying a ton of ore from Duluth to Conneaut, Ohio. Secretary Redfield says that it would make a Norwegian tramp steamer go out of business in despair. This feat in transportation is achieved through labor-saving devices for loading and unloading lake freighters.



Fig. 2.—On the Docks at Ashtabula Are Installed Eight Electrically-Operated Unloaders, Each Having a 15-Ton Bucket. The Unloading Capacity of These Dock is 76,000 Tons in Twenty-four Hours

tents is discharged as required into a larry which runs on an auxiliary track suspended from the under side of the main girders.

Unloading machines of this type have been made in two sizes, the smaller size having a capacity of ten tons and the larger size, shown in the installations illustrated, having a capacity of from fifteen to seventeen tons in the bucket shells. The machine shown is electrically operated throughout. Its speeds are regulated so as to operate through a complete cycle in about 50 seconds.

Eight Machines Unload 70,000 Tons in 22 Hours

In Ashtabula eight machines of this type having a capacity of fifteen tons each unloaded seven boats having a total capacity of 70,000 tons in 22 hours' actual time. At other points four machines working in boats having capacities up to 13,000 tons have unloaded these cargoes in about three hours and twenty-five minutes.

Records compiled by the Wellman-Seaver Morgan Company, Cleveland, Ohio, makers of the apparatus, extending over long periods show unloading costs ranging from 2½ to 4½ (0/1¼ to 0/2¼) per ton, which includes superintendence, labor, repairs and materials on the machines, as well as the cost of power and light.

Operation of the Equipment

After the boat has been placed alongside of the dock the bucket is lowered through one of the hatches into the ore. After filling, the walking beam hoist mechanism lifts the bucket out of the vessel. The auxiliary trolley is then moved backward until the bucket is brought directly over the main hopper between the girders. Here its contents is discharged into the hopper and the bucket returned to the boat for another load. The ore in the main hopper is discharged into the larry, which has been brought to a point directly underneath the discharge gates.

After receiving its load from the main hopper, the larry is moved to a point where its contents can be discharged either into the cars standing on the railroad track beneath the main span of the girders or into a temporary storage pile under the cantilever at the rear of the machines. The ore so placed in this temporary stock pile cannot be reclaimed by means of these machines. Their function is solely one of unloading the cargo from the ships. The

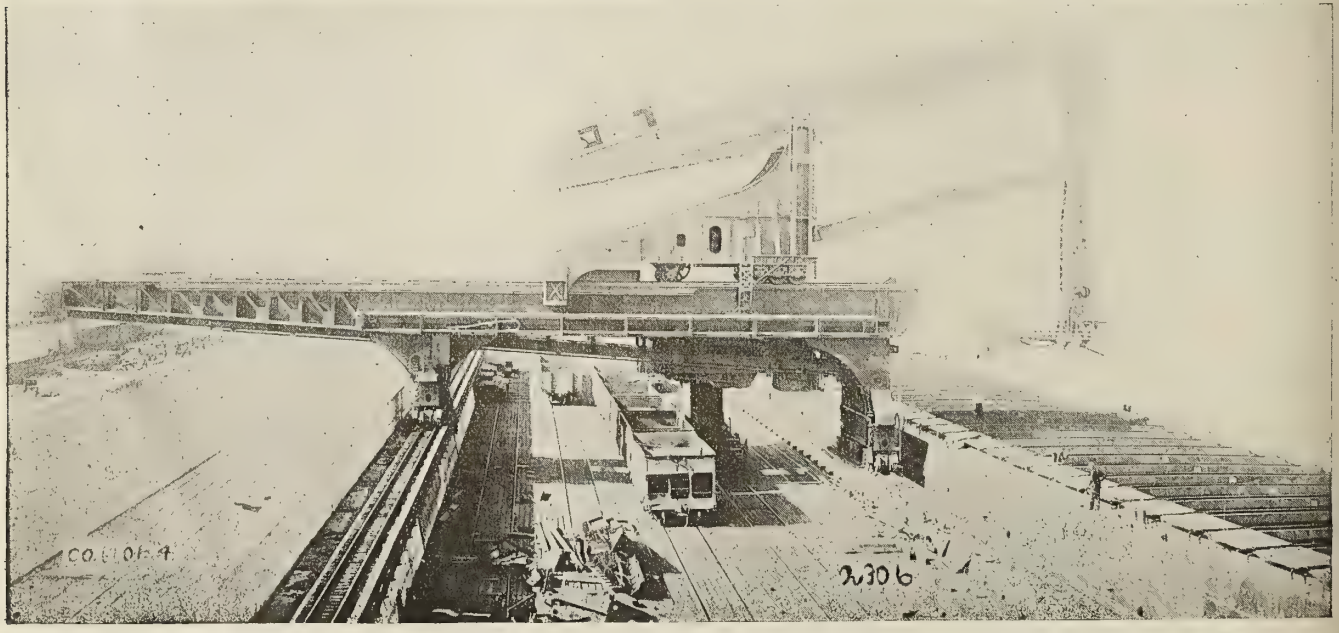


Fig. 3.—View of the Automatic Unloader Showing the Complete Mechanism. Over Fifty of These Machines Are in Use on the Great Lakes Unloading Ore Steamers

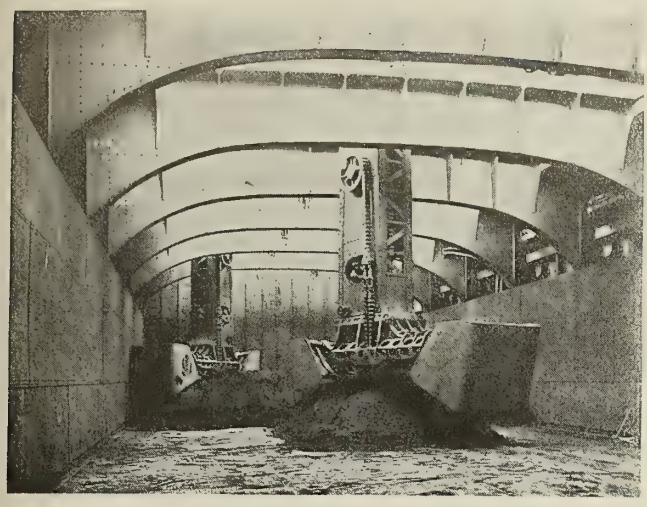


Fig. 4.—Filling Buckets in Ship's Hold

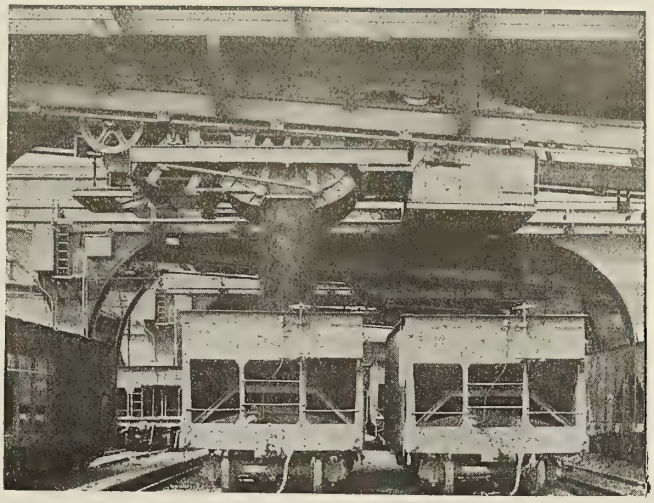


Fig. 5.—Discharging the Ore Into Cars

larry hopper is provided with scales so that the contents is accurately weighed and recorded. In this way a car can be loaded to its allowable capacity and an accurate record kept of the amount of ore so discharged, thus eliminating the necessity for the use of track scales.

Two operators are required for the operation of one of these machines. One, whose station is in the bucket leg directly over the bucket shell, controls all of the motions of raising and lowering the bucket, of traveling the trolley back and forth, and moving the machine along the dock from one hatch to another. The second operator, stationed in a cab on the larry, controls the movement of the larry, the operation of the larry gates, and the weighing of the ore.

In addition to the vertical movement of the bucket, a motion of rotation around its vertical axis is accomplished by a rotating mechanism, located adjacent to the bucket-closing mechanism. This motion is introduced for the purpose of turning the bucket at right angles to the hatchway, in order to secure as great a reach lengthwise of the boat as possible, permitting the bucket to reach out under the hatches and remove ore which is not directly beneath the hatch opening. The distance from point to point of the bucket shells when open is approximately 21 feet.

The scale larry into which the main hopper discharges, has a capacity of between 35 and 45 tons. Two larry loads are intended to constitute a full carload of ore. The position of the discharge gates of the larry is shown in Fig. 5. These are so arranged that all or a portion of the contents of the larry may be discharged. Scales record accurately the amount of ore released. The larry track is inclined; the larry is pulled up the incline by means of ropes and descends by gravity.

Electrical Control

Usually these machines are electrically operated throughout. In some cases, however, machines of the same general type have been made to operate by steam and hydraulic cylinders, water being supplied to the operating cylinders by means of a steam accumulator, which furnishes water at a pressure of 1,000 pounds per square inch. The electrically operated machines are usually designed for a 220-volt direct current. Alternating current is never used. The motors required for the equipment of one of these machines are as follows:

	Number of Motors	Horsepower
Beam hoist	1	275
Bucket closing	1	120
Bucket rotating	1	25
Trolley travel	1	120
Hopper gates	1	100
Longitudinal travel	1	100
Larry travel	1	150
Larry gates	1	40

The control equipment for these motors is of the magnet switch type throughout, having master controllers in the operators' cabs in the bucket leg and on the larry.

Electric current is supplied to these machines by means of insulated conductor rails running the length of the main runways. The current is collected from these rails by means of pick-up shoes and distributed to the various portions of the machine. A similar controlling device is employed for supplying the main current to the trolley. Conductor rails are attached to the main framework of the machine and the current collected from these rails by means of pick-up shoes attached to the trolley.

8,000-Ton or "B" Type Steamship Building at Hog Island Shipyard

AT the Hog Island yard the American International Shipbuilding Corporation is building to the order of the United States Shipping Board Emergency Fleet Corporation two types of vessels, known as the "A" type and "B" type. The "A" type is a single-screw two-deck cargo vessel with a deadweight carrying capacity of 7,500 tons, designed for a speed of 11 knots. Plans of the "A" type ship, showing the general arrangement and scantlings were published in our February issue. The "B" type ship is of 8,000 tons deadweight capacity, but arranged for service as a troop ship and fitted with propelling machinery of 6,000 shaft horsepower, designed to give the vessel a sea speed of 15 knots. The main particulars of the "B" ship are as follows:

Length overall	448 feet
Length between perpendiculars	435 feet
Beam, molded	58 feet
Depth to shelter deck	40 feet
Height between shelter and upper decks	9 feet 6 inches
Height between upper and main decks	10 feet 6 inches
Block coefficient on length between perpendiculars	0.650
Load draft	28 feet
Load displacement	12,900 tons
Shaft horsepower	6,000
Speed	15 knots
Number of passengers (troops)	1,200
Approximate weight of steel hull	3,200 tons
Approximate weight, wood and outfit	800 tons
Approximate weight, machinery	800 tons
Approximate weight, light ship	4,800 tons
Total deadweight on 28-foot draft	8,000 tons
Load displacement	12,900 tons

As in the case of the "A" ship, the "B" type ship is designed without sheer or deck camber. There is no rise of floor and the bilge is turned at a radius of 3 feet 6 inches. The vessel is a single-screw shelter-deck steamer with bridge, forecastle and poop built with a straight stem and cruiser form of stern and fitted with a single mast and eight derrick posts. The parallel middle body extends for a distance of about 15 percent the length of the ship amidship.

The hull is divided by ten watertight steel bulkheads, extending up to the shelter deck, forming seven cargo holds and the engine and boiler spaces. This subdivision of the hull insures that the vessel will float with two compartments flooded at a draft of 28 feet with 60 percent permeability for the cargo spaces and 80 percent permeability for the engine and boiler spaces.

Cargo Holds

The holds and 'tween-deck space are used for cargo except when carrying troops, which are berthed in the upper 'tween decks. The space in the forecastle head is for wet cargo stores, carpenter shop and wash room for the troops; the space in the poop is used for the steering gear, stores and wash room for the troops. In the bridge accommodations are provided for the galley, cold storage stores, etc. At the foreward end of the upper 'tween-deck space forward of the chain locker is used for the stores.

The peaks can be used for ballast or as salt water trimming tanks, while provision is also made for carrying fresh water in these tanks. The entire double bottom, except under the engine space, is arranged for carrying oil fuel. The center keelson is watertight throughout. The double bottom tank under the engine space is subdivided into two tanks for boiler feed by a watertight center division. Wing deep tanks for fuel oil are also fitted, extending up to the second deck.

Hull Construction

As shown by the drawings, the hull is built with transverse framing. Above the tank top the frames are channels spaced 27 inches center to center. In the peaks the frames are angles spaced 24 inches apart; in the inner bottom the frames are angles on both the open and solid floors. The reverse frames throughout are angle bars.

The center keelson is continuous and has a depth of 48 inches. Two longitudinals are fitted on each side of the center keelson, continuous between solid floors. Web frames are fitted in the engine space and also in the 'tween decks over watertight bulkheads and also forward as panting frames. Side stringers are fitted forward in the holds and in the 'tween decks only as required for panting strength at the ends.

The upper and shelter deck beams are channels fitted on every frame. The ten watertight bulkheads which extend to the shelter deck are stiffened vertically, while the forward collision bulkhead is stiffened both vertically and horizontally. Only a single row of pillars is fitted in the holds, but strength is provided by three rows of deck girders, the wing rows being worked clear of the hatch coamings.

Deck Machinery

There are seven main cargo hatches through the second, upper and shelter decks, and a small hatch in the bridge deck which may be used in case coal is burned in the boilers. The hatches are served by fourteen 5-ton booms, two booms being fitted at each hatch. Each cargo boom is handled by a double-cylinder, single-drum, single-geared, reversible steam winch, 8¼ inches by 10 inches.

The deck machinery includes a steam windlass with 10-inch by 10-inch cylinders fitted with two wildcats and two large winch heads for warping the ship; a right- and left-hand screw type steam steering gear with 9-inch cylinders; a capstan with 8-inch by 8-inch engine installed on the poop; two 10-kilowatt electric generators for lighting the ship, and two 4-ton direct-expansion ammonia ice machines. The vessel is heated by steam.

Boilers

Steam is supplied at 200 pounds pressure by six Babcock & Wilcox oil-fired watertube boilers. The boilers are placed athwartships and have a total heating surface of 17,400 square feet. They are fitted with Foster superheaters, which give a superheat of 75 degrees Fahrenheit and are operated under forced draft. The products of combustion are led to a single stack, which has an area of about 94 square feet and extends to a height of 76 feet above the keel.

The oil fuel, which is burned in a mechanical atomizing system, is pumped from the double bottom to a settling tank by a horizontal duplex pump, 9 inches and 7 inches by 12 inches, and then forced to the burner by two horizontal duplex 6-inch and 4-inch by 6-inch pumps.

Main Engines

The main propelling machinery consists of Curtis turbines of 6,000 shaft horsepower, which drive the propeller at a normal speed of 100 revolutions per minute through a 40 to 1 double-helical, double-reduction set of gearing. An astern turbine is incorporated in the ahead casing, designed to develop two-thirds of the full speed ahead torque on not more than two-thirds of full speed revolutions of the shaft.

The propeller is a solid four-bladed wheel 18 feet in diameter.

Engine Room Auxiliaries

The engine room auxiliaries include a main condenser with about 8,500 square feet cooling surface, a centrifugal double-suction circulating pump with 20-inch suction and discharge and a capacity of 10,000 gallons per minute against a head of 15 feet driven by a single-cylinder reciprocating engine 10 inches diameter by 12 inches stroke; a wet and dry twin-beam air pump, and the following service pumps:

Two vertical simplex main or auxiliary feed, 14 inches and 9 inches by 24 inches.

One horizontal duplex ballast, 10 inches and 12 inches by 12 inches.

One horizontal duplex fire, bilge and general service, 12 inches and 8½ inches by 12 inches.

One horizontal duplex sanitary, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex engine room bilge, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex fresh water, 6 inches and 5 inches by 6 inches.

Two horizontal duplex evaporator feed 4½ inches and 3¾ inches by 4 inches.

One horizontal simplex combined air and circulating, 10 inches and 12 inches and 12 inches by 12 inches.

One horizontal duplex oil transfer, 9 inches and 7 inches by 12 inches.

Two horizontal duplex lubricating oil, 7½ inches and 6 inches by 10 inches.

Two horizontal duplex oil service, 6 inches and 4 inches by 8 inches.

One horizontal duplex ice machine circulating, 6 inches and 5¾ inches by 6 inches.

The auxiliary equipment also includes a feed water heater, feed and filter tank of 1,200 gallons capacity, two evaporators with a capacity of 20 tons each per twenty-four hours, and an auxiliary condenser of 800 square feet cooling surface.



Fig. 1.—Proposed Commercial Pier No. 9 North. Department of Wharves, Docks and Ferries, City of Philadelphia

Port Improvements at Philadelphia

Comprehensive Developments Planned—Construction Begun on Three Piers Costing Over $3,000,000—Two New Piers in Service

ALTHOUGH little has been said regarding the new harbor developments at Philadelphia, the city officials are silently forging ahead in an effort to provide the most advantageous shipping facilities possible.

On December 1, 1918, the city completed the construction of Pier No. 78, South Delaware wharves, the first of the Moyamensing piers. These consist of two groups, the upper group comprising four piers 900 feet long by 250 feet wide, and two piers 900 feet long by 300 feet wide, with a 300-foot waterway between the piers; the lower group consists of four piers, each 1,200 feet long by 300 feet wide, with a water span between the piers of the same width. The Philadelphia quartermaster terminal is situated between the groups.

The pier head of Pier No. 78 is shown in Fig. 2. As may be noted, it is of the double-deck type, with office buildings and three-deck bulkhead sheds at its inshore end. On the outside of the building depressed car tracks

* Data supplied by George S. Webster, Director, Department of Wharves, Docks and Ferries, Philadelphia, Pa.



Fig. 2.—Inshore Elevation of Municipal Pier No. 78

have been built, and a wagonway has been constructed through the center of the pier. The cost of the project has been approximately $1,814,000 (£372,000).

Details of Kenilworth Pier

On February 17 of this year a contract was awarded for the construction of Pier No. 30 South to the F. W. Marks Construction Company, Finance Building, Philadelphia, Pa. This pier, located at the foot of Kenilworth street, will be of a double-deck permanent structure, 540 feet long by 120 feet wide; it will be used for ocean steamship traffic.

The substructure will be of the timber, pile and concrete cross wall type, decked with a reinforced concrete beam and slab construction, designed for a live load of 600 pounds per square foot. The pier will be paved with asphalt blocks except at the railroad tracks, where vitrified blocks will be used. The superstructure will be a one-story steel and concrete shed, 110 feet wide by about 520 feet long, with architectural concrete elevations on the Delaware avenue and river ends.

Flanking each side of the pier at the inshore end will be constructed one-story steel and concrete bulkhead sheds. These will be 32 feet wide by 64 feet long. The pier will be equipped with two surface railroad tracks connecting with the Belt Line Railroad, and cargo masts will be installed along the full length of the dock sides of the pier. The estimated cost of the construction is $950,000 (£195,000). The company's bid was $908,420 (£186,000).

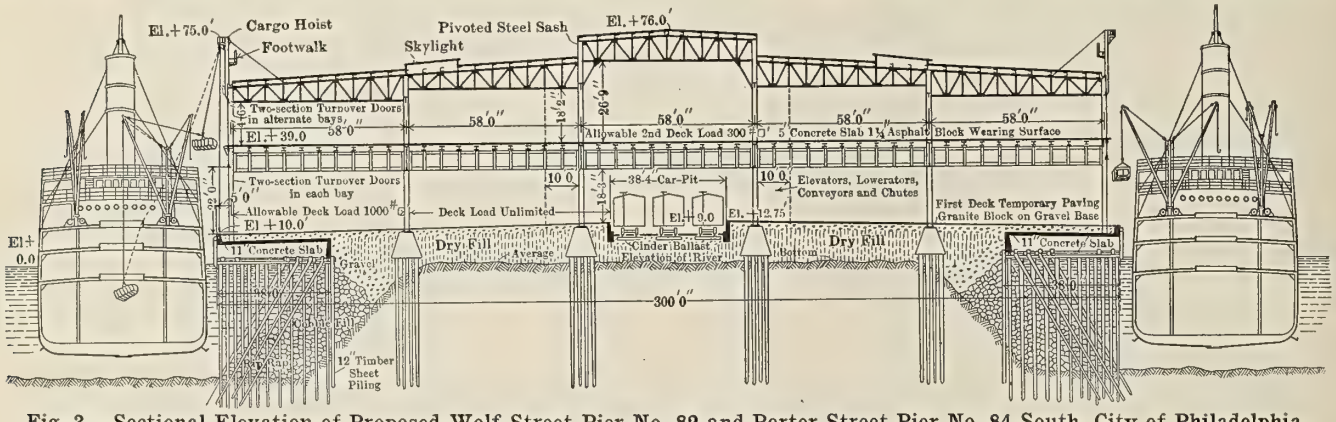


Fig. 3.—Sectional Elevation of Proposed Wolf Street Pier No. 82 and Porter Street Pier No. 84 South, City of Philadelphia. Department of Wharves, Docks and Ferries

Two 900-Foot Piers

In March a contract was let to the Arthur McMullen Company, 149 Broadway, New York, for the building of Piers Nos. 82 and 84 South. These piers will be 300 feet in width by 900 feet in length. The contract at the present time is for the substructure only, which will be of solid fill type. As may be noted from the illustration, the solid earth fill will be retained by a pile, timber and concrete construction of the cross wall type; this will be about 38 feet in width, forming the sides and outshore end of the pier, the fast land of the inshore end constituting the closing side. Bulkheads of the same type will connect the two piers and extend to the north and south of them approximately 200 feet. The company's bids estimated the work at $2,266,400 (£465,000).

Pier for River Steamers

About June 1, Pier No. 9, North Wharves, which is 100 feet wide by 535 feet long, was completed. This pier, which is intended primarily for the use of river steamers, has a deck level track connecting with the Belt Line Railroad, and is equipped with six wharf drops or adjustable ship gangways. The deck is of reinforced concrete beam and slab construction, paved with asphalt except where vitrified brick are used around the railroad tracks. The pier is capable of supporting a superimposed load of 600 pounds per square foot. The superstructure is 90 feet wide by 520 feet long, fire-proof throughout, with architectural concrete elevations on the Delaware avenue and river ends. The estimated cost of the work is $450,000 (£92,200).

The above description covers piers actually under construction. Other improvements, however, have been planned by the Department of Wharves, Docks and Ferries, which, when completed, will further increase the harbor facilities.

Future Construction Plans

The Penn Treaty pier, which it is proposed to build as an extension to the present open recreation pier, will provide a lower deck for the accommodation of freight and passenger river steamers, and an upper deck for recreation purposes. Permanent structure will be used for the new pier, the substructure being of concrete on timber piles, cut off at the low water level, and the superstructure of structural steel and concrete. The lower deck, which will be 70 feet wide by 300 feet long, will accommodate a live load of 400 pounds per square foot. This dock will be paved with asphalt, and enclosed on the dock sides with sliding doors 20 feet wide by 15 feet high. The estimated cost of the entire construction is $355,000 (£73,000).

New Pier at Foot of Allegheny Avenue

Plans and specifications are also being prepared for the construction of a double-deck pier, to be built on the property now owned by the city at the foot of Allegheny avenue. This pier, to be known as Pier No. 127, North Wharves, will be provided with two surface railroad tracks, one on each side of the pier outside of the shed connecting with the Philadelphia Belt Line Railroad, and will be equipped with cargo masts along the entire length of the dock sides of the pier. The superstructure will be a two-story steel and concrete shed, 106 feet wide by approximately 610 feet long. One million dollars (£205,000) is given as the estimated cost of the construction.

Besides these piers, to be used for commercial purposes only, it is planned to build a new recreation and steamboat pier for the use of small pleasure craft, to cost about $100,000 (£20,500). Comly street recreation pier will also be enlarged, at an estimated cost of $10,000 (£2,050).

The Marine Terminal Railway

General Principles Governing Location and Arrangement of Tracks and Movement of Freight

BY H. MC L. HARDING*

THE terminal railway comprises the railway tracks within the limits of the terminal area and is to be considered as under separate terminal rules or principles rather than in accordance with the usual railway practice. For example, it is desired by railway engineers to have the radii of the track curves as great as possible and not less than about 358 feet radius, while terminal engineers, within the terminal, desire to have these curves as small as commercially practicable, and in general have the lower limit about 150 feet radius. Freight cars can readily be drawn around a 150-foot radius curve without extra connecting links.

Radius of Curves

The reason for the smaller radii is to avoid reserving too much valuable waterfront space for the track curves. The area for a 358-foot radius or 716-foot diameter would be difficult to secure at most marine terminals. Where, however, the terminal railway lead leaves the trunk line or siding, then the curve and frog should be what the railway company may desire.

By the terminal engineers adhering to and insisting upon the application of terminal principles within the terminal grounds, as are established or may be established by the Society of Terminal Engineers, long, futile arguments will be avoided.

At a public terminal on the quays where all kinds of freight are transferred there should be two or three railway tracks for outbound freight located between the edge of the quay wall and the shed.

Location of Railway Tracks

If the front of the shed be located 35 to 40 feet from the edge of the quay, then for two tracks the center of the track nearest the shed may be about 28 feet from the edge of the quay and the center of the second track about 15 feet from the edge of the quay. Where the width is 35 feet and there is a full arch crane spanning the outside track, these relative dimensions are modified.

These tracks should be parallel to the quay wall and the top of the rails flush with the pavement, the same as car tracks in paved streets traversed by vehicles, so that the track space can be readily traversed by drays.

Where there are to be three tracks along the quay frontage, there should be about fifty feet between the front of the shed and the edge of the quay. In this case the center of the track nearest the shed may be 43 feet from the edge, the center of the second track 30 feet distant, and the center of the third 17 feet.

The above distances are subject to modifications, but may serve as a general rule. It is desired to have sufficient space between the cars on the tracks nearest the quay edge for the travel of drays. Much freight in the future will be drayed to and from terminals within a radius of 30 miles by large motor trucks.

If there should be no buildings—that is, an open quay—the above spacings may be observed. The above pertains to public terminals where all kinds of materials are to be transferred and handled, and not to an iron ore or coal terminal.

With two tracks there should be cross-overs from one track to the other about every 100 feet. These cross-overs can be so arranged that at one time one track can be the switching track and at another time the loading track. Where there are three tracks, the center track is generally the switching track and the other two tracks the unloading or the loading tracks.

The front quay-wall tracks are usually termed co-ordinating tracks and are largely used for outbound freight—that is, from car to vessel; but if no vessel be present, then from car to shed. At Baltimore, according to the report of the Port and Harbor Facilities Commission of the United States Shipping Board, more of the outbound freight is transferred directly. These tracks can also be used for inbound freight, although most inbound freight must first be transferred into the shed for assorting and distributing. The tracks to the rear of the shed are chiefly for freight from the shed to the interior. These rear tracks should be connected at convenient locations with the front tracks.

Track Approaches

As in many cases, where the quay wall is projected into the stream, then to reach the front portion of the quay the railway track approaches are on trestles, which, as the adjoining units of the quay are constructed, are usually filled in.

The location of the tracks at the rear of the shed will vary, depending upon the design of the shed whether the doors are continuous in every bay or in every other bay and whether the warehouse is located within about sixty feet to the rear of the shed and parallel to it.

Co-ordination of Terminal Elements

To secure a succession of rapid mechanical freight movements, all the elements of the terminal must be co-ordinated and work in unison. The most rapid loading of railway cars has no advantage unless the necessary number of empty cars are placed in position for loading and unless the cars already loaded are taken away. Similarly, in the unloading of cars, the empties must be at once removed and then the place filled by full cars.

The quick movements of these cars depend upon the terminal track layout. The spacing of two tracks at the Continental ports varies from 14 feet 9 inches to 16 feet 5 inches, differing a little from American practice. The method of operation is generally that, when the cars on one line of tracks are being loaded, the switching engine brings in a train of empty cars on the second track and takes the full trains away, and then the same method of procedure is carried on, only on the other tracks; therefore each line of tracks is successively used as a switching track nearly the same as with American practice.

Two-Track Operation

A continual succession of these car movements will only be possible if all the cars are loaded within the same time and a corresponding number of cars stand ready for loading or discharging at each crane.

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At a terminal for miscellaneous freight this is seldom possible. As a rule, one or another of the tracks must be used for a switching track. The rails cannot, therefore, be occupied completely by cars. They must be kept open at the switching points. As a rule the operation should be so regulated that first the rails must be cleared of the loaded cars and then the empty cars drawn up.

Three-Track Operation

With three tracks these difficulties disappear, but too often there is not space for the three tracks. It may be said that there should be cross-overs on each side of the space served by one crane, so that as soon as cars in this space are loaded or emptied they can be removed. With a sufficient number of tracks, the placing and the removing of cars can take place without interfering in the least degree with the work on the quay.

If sufficient quay space in width can be secured, large sums can be saved in rail extensions. In some cases, where there is not much fluctuation in water levels, as along canals, and there is a sloping bank, one leg of the quay crane can be placed on a low wall a little above the water level, so that space can more easily be acquired for the additional third quay rail track.

At a railway terminal, where there is to be speed and successful operation, the rail track approaches to the different terminal locations should usually be at least double and ample for the inbound and outbound car movements.

Depressed Tracks

The rails of the tracks are sometimes depressed so that the floor of the car is even with a platform at the rear of shed. If, however, there are continuous doors with dray service only, not cars, then the platforms are not so essential. Canopies over the platforms interfere with overhead transferring machinery.

One great disadvantage of the depressed track is that it is difficult to transfer freight between the shed and warehouse by motor trucks or other trucks on the surface. Transferring cranes of various types can easily perform this service or it can be done by conveyors above the depressed tracks and cars, without interfering with the moving trains.

Freight Movements Between Shed and Warehouse

There are disadvantages in having two-story sheds with a few overhead platforms from shed to warehouse, as there is much travel both in the shed and warehouse to reach these cross-over passageways. A warehouse generally has six or more stories, all of which must be served. A crane with a jib able to travel the whole length of the shed and warehouse and connect the two at any point gives much greater flexibility of service than having only the few overhead platforms within the length of each marine berth of six hundred feet or more. The crane can transfer from the shed to any of the stories of the warehouse by any direct movement.

Waterfront property is so much more valuable than the land a few hundred feet to the rear that warehouses where freight may remain for months should be located on the rear lands with correctly planned railway tracks and drayways.

In most instances a 60-pound or 85-pound rail will suffice for terminal tracks. The ties, however, should be spaced closer than is the usual practice, and the ties should also be longer. This is especially advantageous for the tracks in front of the shed so as to distribute any excessive loads of the locomotives and cars over as large an area as possible.

Tracks can be extended into and through the lower story of the warehouse, but never within the shed.

The spacing of the tracks in the lower story of the warehouse will depend upon the design of the terminal warehouse, but there should also be an easy mechanical transference between the cars and the upper stories within the warehouse, chiefly by elevators.

Placement and Storage Tracks

The tracks, the location of which has already been described, may be called the movement service tracks. There should be other tracks near the quay or pier for placing full cars for immediate shipment and empty cars for receiving incoming cargoes. At a greater distance from the quay, and from the sheds and warehouses should be extensive storage, classification and other terminal tracks.

The placement and storage tracks may conform to the standard types of ladder tracks. As a rough guide to the length of storage tracks necessary, and only to indicate a method for estimating this trackage, the following may be of service:

Length of Trackage Necessary

The quay for ocean-going ships may be considered as composed of units, each unit with a berthing frontage of 600 feet.

If there are four steamships, each unloading 5,000 tons of cargo for through freight, there would be required to contain the 20,000 tons of cargo from 1,500 to 2,000 cars, if all is through freight. As one part may be for local delivery and another for transshipment, and still another for the warehouse, it might be safe to consider that there should be provision for 1,000 cars to receive this freight.

A low average for the through freight from a ship is 50 percent.

Besides these empty cars there may be an average of 500 full cars waiting to be unloaded into ships, warehouses and sheds.

One thousand five hundred cars, allowing 40 feet for each car, would require a trackage of about 60,000 feet, or from ten to twelve miles.

The above figures are given only to show the necessity for providing ample space for storage and other tracks and not as any absolute rule.

It often happens that the trunk line railway or railways have extensive storage tracks near a terminal, and, as the railway will greatly profit by this through traffic, these storage tracks can be utilized to advantage for the terminal.

On piers there should be railway tracks on each side within a space of thirty-five feet in width, with cross-overs between the two tracks.

In many cases it will be found to assist in rapid transference of the freight, if the terminal railway tracks are first located and then the terminal buildings. Placing the warehouses diagonal to the waterfront, where there are piers, has greatly facilitated the track layout.

Conclusions

First.—The terminal railway tracks should, in the layout, conform to terminal engineering principles.

Second.—There should be direct co-ordination between ship and rail, and the loading and unloading should go on continually, planned so as to avoid possible congestion.

Third.—Mechanical appliances should be installed for transference and handling to secure speed, and outbound freight, when possible, should be transferred direct from car to vessel.

Designing Marine Machinery for Economy

Features of Machinery Design That Affect Fuel Consumption of the Ship—Reduction and Simplification of Piping—Furnace and Condenser Losses

BY COMMANDER H. C. DINGER, U. S. N.

MOST marine machinery is designed to run and to be reliable, to weigh as little as practicable and to cost as low as possible; but few ships and machinery are designed on the basis of economy of fuel consumption. Of course, this is considered. Nowadays the water rate of the engine is looked into; some consideration is given to securing a good vacuum, and even superheat is investigated. But economy of fuel as a constant ideal in the minute details of design is usually treated as an unnecessary and pestiferous refinement.

The designer often studies the question of weight; but does he remember that economy of fuel is the greatest possible saver in weight, and one that is always on the job? Does the designer always consider that the lead of piping or the design of the cut-out valve affects fuel economy? Perhaps some do occasionally, but as a general rule the piping is led to get there and any valve that is available is used.

An object lesson in designing for economy is indicated in the performance of groups of the United States 35-knot destroyers. In the vessels built by one yard the oil per knot is materially less than that of vessels turned out by several other builders. Now, this big difference, particularly at the high powers, was not obtained by magic, nor at an increased cost of manufacture, nor by the use of superior material. The better-designed vessels are the cheapest on the actual cost basis. It was produced by designing the ship and all the details in her with a special consideration for fuel economy. The result—they cost less, weigh less, use less fuel, have higher speed, and are more durable.

Now, the ideas that secured this marked result on these destroyers can be made use of in designing any marine installation. They are not mysterious, hidden, or intangible. They are just as simple as two and two make four. It is necessary always to keep in mind the principle of conservation of energy, that the force of gravity exists, and that heat and mechanical energy are mutually convertible, that friction is a loss whether it is in a bearing or in a water pipe.

Here are some of the matters often neglected, or not fully considered.

The loss due to friction in piping systems.

The steam economy due to simplified piping.

The direct routing of steam and water through the piping systems.

Permit the forces of nature to help rather than work against them.

Friction in Piping

This can be decreased in the following ways:

1. Reduce the amount of piping.
2. Place the parts to be connected as close to each other as possible.
3. Do not reverse directions of flow, if possible to avoid it.

Here are some instances where friction is unnecessarily increased: (1) Return flow condensers and feed heaters; (2) the placing of condenser tubes athwartships. The reversal of flow means greater resistance to the pump and the need for more surface. The movement of the ship naturally causes any medium to go from forward aft in line with the keel; yet how much water on board ship is unnecessarily moved from side to side or even from aft forward?

Sharp corners and abrupt angles in water and steam piping mean increased resistance and loss in friction. Easy bends and the fairing up of angles help to design for economy.

The loss due to friction in pipes applies to water, oil and air pipes as well as to steam pipes. The sum total is, of course, not over a few percent of the total power. However, a very large part of it is an unnecessary loss, and therefore one that should not be permitted in good design. "Many a mickle makes a muckle," and when we are designing for economy no half of one percent or hundredth of one percent should be lost, if a little more care in design will save it.

Uptake Temperature

This is almost a stranger to many who are building and operating ships; but whether of high or low degree, most designers and operators scarcely take the trouble to inquire except to assume it exists at some figure. The temperature of the feed water entering the boilers is rarely ever much more than 200 degrees. If we are designing for efficiency, our uptake temperature should not be so very much greater than this; certainly not over 300 degrees F., thus allowing 100 degrees F. temperature difference—really an ample margin. This ought to be a pretty fair allowance for any heat transfer apparatus that has any reasonable claims for efficiency. Our condensers and feed heaters get down to a temperature difference of about 5 degrees F. to 10 degrees F. by using the counterflow principle. Why not take a hint and allow our boilers the same privilege? It can be done. Will not someone try it?

Condenser Losses

It may be a little startling to say so, but there is less load on a condenser when you have the highest vacuum than when you have a poor one. Most marine condensers have considerably more surface than is necessary to condense the steam, and yet do not produce a particularly good vacuum. Surface does not produce the vacuum; it condenses the steam. The vacuum depends more on the air tightness of the condensing system and the efficiency of the air pump, and, of course, no air pump can overcome a very bad air leak. In designing for economy, therefore, see that you actually have plenty of circulating water, and that your condensing system is airtight—not nearly airtight or reasonably airtight, but *actually* airtight. Do this by avoiding joints and connections, and where a joint has to be, don't hide it. Avoid all possible occasions for air leaks.

Any condenser will condense the steam fairly well if it is given plenty of water, but many marine condensers seem to be designed with the misguided intention of holding on to the water, instead of letting it slide through the condenser just as fast and as easily as possible. There is plenty of water in the ocean, so why not use it? We have return flow and even triple pass marine condensers, and the resistance to the flow of water on some of these

is something not to be sneezed at. All this resistance adds to the fuel bill.

Since the vessel moves through the water, a scoop is the most natural, simple and inexpensive way to get the circulating water to the condenser. But how few of the total marine installations use this! Of course we need water when backing or maneuvering, but a small circulating pump on a by-pass and the main injection will supply that. A single-pass scoop condenser has greater capacity and efficiency than any other marine type, and you can dispense with the large circulating pump which, of course, is never large enough in the tropics. The scoop, however, increases its capacity with increased speed and has no bearings to get hot.

Balance

Does this affect the coal pile? The connection is a bit roundabout, but it certainly does affect fuel consumption. Unbalance is like a leak in a pipe; it allows energy that should be spent in driving the vessel to amuse itself tearing things to pieces. Do we look at it in this light or is it only when it gets so bad that things won't hold together that we deign to seek the acquaintance of two supposedly mysterious elements—*static* and *dynamic* balance? It is well to have them with you in motors, shafting and propellers. They are not very difficult to secure. They come almost naturally with good workmanship. If we balance our shafting and our propellers carefully, we not only prevent the ill effects of vibration, but we then build for economy. Furthermore, by carefully balancing we are likely to discover hidden flaws and irregularities that otherwise would not come to light.

Vibration is the visual manifestation of unbalance. When all moving parts are properly balanced, vibration is very much reduced. The machinery, of course, will operate even with considerable vibration, but the presence of vibration means loss in fuel, if it does not mean anything more serious.

Temperature Difference

Marine machinery has incorporated in it much heat transfer apparatus, namely: Boilers, condensers, feed heaters, oil heaters, oil coolers, evaporators, etc., etc. Now the capacity of any heat transfer surface is a function of the temperature difference. In designing for economy this must always be before one, and no good chance to increase the temperature difference is to be neglected. A larger temperature difference permits greater capacity per unit surface and hence saves weight and space. A proper consideration of temperature difference makes it possible to save for a useful purpose a great deal of what may otherwise be waste heat. This applies particularly to boilers (where all possible heat in furnace gases should be extracted) and to condensers (where as little heat as possible should be taken away by the circulating water).

Air

Air is desirable in its place to breathe and to support combustion, but in nearly all other parts of marine machinery it is the enemy of efficiency. Air is really more pestiferous than salt water because it gets into so many more places where it is not wanted. Here are a few:

(1) Air in the water side of boilers causes corrosion.

(2) Air, particularly warm air, in copper piping causes corrosion.

(3) Air collecting on either side of the surface in condensers, evaporators, distillers or feed heaters renders the cooling or heating surface inefficient, besides causing corrosion.

(4) Air in oil lines on forced lubrication causes improper flow of oil and interferes with the drainage of the oil.

It is therefore plain to see that one of the guiding lights in designing marine machinery should read, "Design to keep air out," and then, "Design to take it out when it does get in." Air can have access in so many ways that all these ways must be considered and avoided if the designer wants the best economy.

Inclination of Shafts

The shafts transmit the driving power, and this tends to drive the ship parallel with the axis of the waterline. If the shafts are not parallel to this, there is loss of power. It is therefore important that the inclination of shafts be as small as the structural limitations will permit.

Fairing Up of Underwater Body

If one believes the surface of a vessel is smooth, let him but examine one in dry dock. All manner of obstructions will be found. Rivets are not flush or smooth; sea openings have reinforcing rings that are direct obstructions, with no attempt at bevelling or stream lining; shaft hubs and struts are not made of stream line section, and the strut arms are often very close to the propellers, so close that they disturb the water going to the propellers and cause a certain amount of cavitation; bilge keels and rolling keels are often attached so that they offer much resistance; the plating in many cases has cavities, indentations and rough places that are not smoothed up or filled in.

The need of docking a vessel to remove barnacles is appreciated, but the equal need of starting out with a smooth metal surface seems sometimes to be lost sight of.

The best of our marine power installations expend about one hundred heat units to do the equivalent of twenty-five units' work. There are the following conversions: (1) Combustion in the furnace; (2) furnace heat into the heat of steam; (3) steam heat into mechanical energy in the rotating shaft; (4) the energy in the shaft into propulsive energy to drive the vessel. There are losses all the way along from the beginning of (1) to the end of (4). They may be represented approximately as follows:

100. Heat units in the coal.
80. Boiler efficiency, 80 percent.
72. Ten percent of steam for auxiliaries.
69. Less losses in piping and radiation, 2 percent.
48. Turbine efficiency, 70 percent.
46. Losses in gearing and shafting, 5 percent.
30. Propeller efficiency, 65-70 percent.
26. Excess hull resistance due to rough hull and appendages and inclination of shafts, 12 percent.

This represents a plant with a tight system of piping. Steam and water leakage, poor vacuum, etc., in whatever extent present, add still further to the losses.

Of the above sources of loss, the following are the ones that at present appear most likely to be remedied by better design and workmanship:

Boiler Efficiency

There are no insurmountable reasons why a boiler efficiency of 90 percent should not be secured in ordinary practice. By laboratory methods, about 95 percent can be secured.

Excess Hull Resistance

The proper stream lining and smoothing up of all hull obstructions and appendages can in most vessels reduce the required driving power 5 percent or more. The higher the speed, the more important this matter is.

Propellers

Well-designed propellers may easily make a difference of 5 percent over the ordinary ones supplied.

Oiling System and Bearing Designs

Success of System Described Depends Upon Workmanship and Attention Paid to Fitting Same—Old Practices Should be Stopped

BY ENGINEER-LIEUTENANT A. E. WINDRAM

BY A few rough sketches, the writer indicates how it is easy to make the majority of existing main bearings, crank pins, bearings and crosshead bearing brasses, oil-tight, on nearly any reciprocating engine, or, in fact, any bearing that requires good, careful oiling, by means of drilling crank webs into oil rings or grooves turned round the center of the journal, and corresponding oil rings or grooves in the center of the brasses connected with pipes from brasses to brasses, which are made oil-tight by sealing rings on the ends of the brasses.

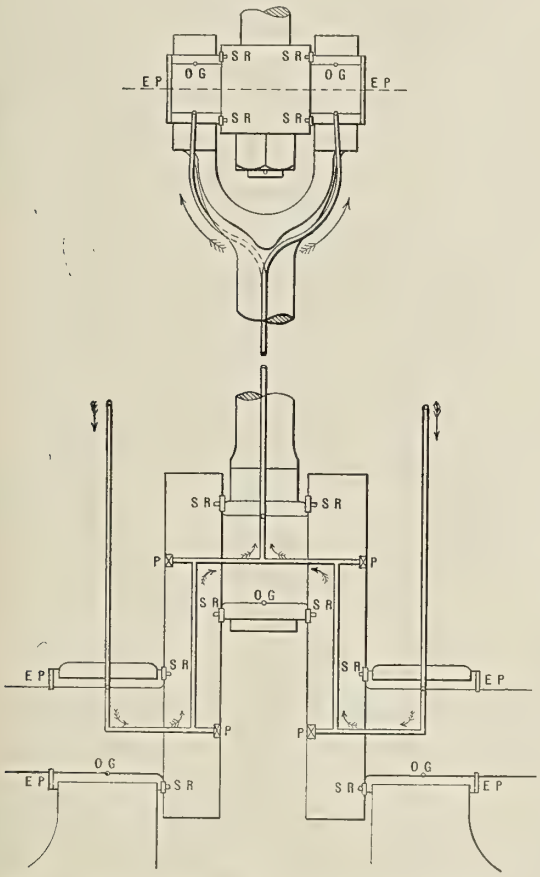


Fig. 1.—General Outline of System and Bearings That Will Retain Oil by Means of Sealing Rings and End Plates

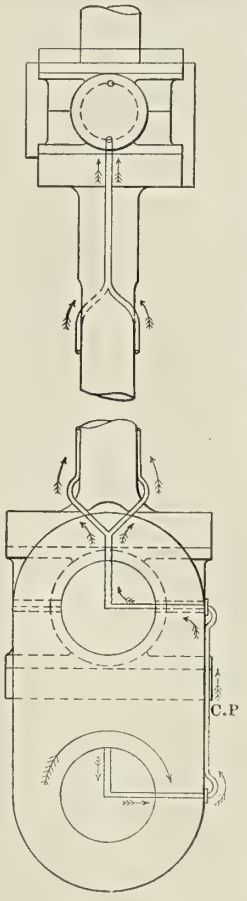


Fig. 2

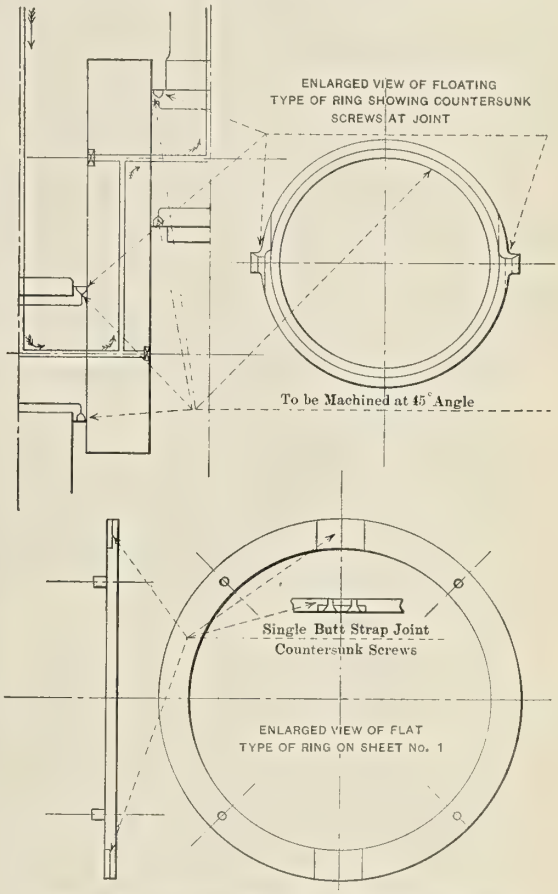


Fig. 3.—Another View of a Floating Type of Ring

Fig. 1 shows the general outline of an oiling system and bearings that will retain the oil by means of sealing rings (*SR*) and end plates (*EP*). The bearing journals have oil grooves (*OG*) turned in the center of the journals, as indicated by small circles, a half-circle groove in the journal and a corresponding half-circle groove in the bearing. The main bearing and crank bearing journals are drilled from the oil grooves to the center of the shaft, and the shaft is drilled longitudinally to meet a vertical hole in the journals; the center holes in the shaft have the ends plugged (*P*).

On Fig. 2 the crank webs are shown drilled horizontally from the edge of the web to the center. The main bearing oil hole is put into connection with the crank pin oil hole by means of a connecting pipe (*CP*), which is bolted to the outside of the crank web, as the process of drilling through the crank web from the crank pin down to the main journal oil hole is more difficult. The large arrow of rotation from left to right shows the pipe (*CP*) as leading the crank when running, so that any centrifugal effect will cause the oil to flow towards the crank journal.

The sealing rings (*SR*), as shown in Fig. 1, are let into grooves turned in the sides of the crank webs; also, holes are drilled in the center of the grooves to receive the pegs at the backs of the sealing rings, so that the rings cannot turn round with the brasses, but act as scrapers. Light springs on the pegs at the back force the rings on to the sides of the brasses. A slight recess is turned on the sides of the brasses for the rings to run in, thus making a good running joint and stopping all leakage of oil.

A larger view of a sealing ring, termed a flat type of ring, is shown in Fig. 3. The ring is built up in halves with two flush joints, and with four pegs to keep the ring in position. Fig. 3 also shows another view of a floating type of ring, with a V-section, sitting in a groove, one

* Paper read before the Institute of Marine Engineers, London.

side running on the journal and the other on the brass. This ring is built in halves, can be fitted and adjusted, but is free to float round either with the journal or brasses and keep oil-tight.

Referring again to Fig. 1, it will be noticed that the main bearings have an end plate (*EP*) fitted that sits in a small groove or recess in the shaft, and is bolted on to the end of the brass, thus sealing up the oil and stopping any leakage along the shaft. If found necessary, a ring could be fixed to the shaft just touching and jointing with the fixed ring on the end of the brass; in fact, there are innumerable ways of sealing up the ends of the main bearing brasses. The crosshead brasses have end plates bolted on, thus sealing up the bearing round the pin.

In Fig. 1 the oil enters the pipes leading through the main bearing cups into the oil groove circle round the shaft. The oil is free to travel all around the bearing by suitable channels in the brasses; at the same time it passes into the hole drilled to the center of the shaft, and along longitudinally to the crank webs, and then at right angles from the center to the outside of the crank webs (Fig. 2). The oil next travels through the pipe (*CP*) to the center of the crank pin shaft, then at right angles along to the center of the crank journal and up to the oil groove circle turned round the center of the pin and brasses, so that the whole of the "bottom end" brasses are floating round the crank journal in oil supplied through suitable channels in the brasses. The foot of the connecting rod (Fig. 2) is drilled in the form of a *Y*, because two pipes are required to run up the connecting rod so that the oil can be conveyed through the crank pin brasses up through the foot of the connecting rod and out into the two pipes up the crosshead brasses. The two pipes are fitted round the fork end of the connecting rod and up through the bottom brass into the oil groove circle turned round the crosshead journal pins; thus the crosshead brasses are kept floating in oil.

The pipes leading into the main bearings (Fig. 1) can be led to oil reservoirs placed above the cylinder covers, so that if gravity fed, the oil is bound to go up the pipes and up the connecting rods to lubricate the crosshead bearings, or the pipes leading into the main bearings can be connected to small hand pumps, so that the oil can be pumped through the system. Not more than 5 or 8 pounds per square inch pressure would ever be required to reach any crosshead bearing.

The success of this system of oil-tight and oil-retaining bearings will depend upon the workmanship and attention paid to fitting same.

The old method of putting tins into bearings so that "you can just hear her knock," and filing away the sides of the brasses so that the only touching place is the crown of the brass, are practices that should be stopped. Well machined brasses and journals should be fitted together with a fine working fit; otherwise, if the journals are to continue to flap about inside the brasses, no oil will ever remain in the bearings. A true pin and a true brass will run when quite finely adjusted, providing the oil is sure of getting to the rubbing surfaces, and the oiling system proposed, with proper workmanship, appears to the writer well adapted for the purpose designed and sure to give satisfactory results in actual practice.

Observations on Side Launchings

Arrangement of Blocking—Progressive Loss of Support as Vessel Goes Down the Ways—Lifting and Tipping Pressures

BY JOHN A. MC ALEER*

THE advantages of building a ship on a level keel with the subsequent idea of a side launching are too well known to require comment. It has been, and is now, the universal practice on the Great Lakes and has lately been adopted in some yards on the coast. Articles on this subject have appeared at somewhat protracted intervals. Most of these, however, have over-emphasized the simplicity of any calculations, as well as the uniformity of hull support. In this short article it is proposed to focus the attention of interested persons on the necessity of making some calculations, simple though they may be, before launching in this manner.

It might be well to remember that all the phases of an end launching are present in a side launching, though occurring more rapidly. With a large ship an end launching may require a minute; but if this same hull had been put in sidewise, the whole operation would have been over in about one-tenth of that time. Events are therefore transpiring ten times as rapidly. Nevertheless, the critical condition of lifting or tipping may be present, and very frequently for a period sufficient to set up and damage the vessel's bottom.

Fig. 1 shows a cross-sectional view of a vessel ready for such a launching. There are generally five rows of fore and aft blocking, a center row under the keel and two outboard lines on either side. This represents what must be considered general good practice. The construction of these rows of blocking is practically identical so far as bearing surface is concerned and otherwise, except that in the outboard blocks on the water side more stability is often secured by cross ties or by increasing the base areas. They are also carried as far forward or aft as the fineness of the buttock lines will permit, but this consideration results in there being a smaller number of blocks in these outboard rows and a consequent decrease in bearing surface in this region.

The ways are timbers, generally of oak, 18 inches by 24 inches or thereabouts, placed at equal intervals along the launching berth. The spacing of these varies in different yards, but it is from ten to fourteen feet. The usual practice is to place them at regular and equal intervals, but whether this is a practice that could be bettered will be considered later.

A vessel blocked up in this manner preparatory to launching will be well supported at all points, and the pressure between ways and butter boards will not be too large.

Take, for example, a full canal-sized, lake-built ship 261 feet by 43 feet by 28 feet, with an estimated launching weight of about 1,300 tons, supported on 19 ways and 5 rows of blocking, affording 19 keel blocks, 13 or 14 blocks in each No. 1 row, and perhaps 8 or 9 in each bilge row, or about 60 blocks for a total. This will give about 22 tons per block, and, assuming 6 square feet of bearing surface per block, a pressure of about 3½ tons per square

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foot. This is a very moderate pressure, but let us see whether this is a fair way of analyzing the launching conditions.

As the vessel slides down the ways there is a rapid and progressive loss of support as each line of blocking passes beyond the way ends, and, consequently, a sudden increase and localization of bearing pressures. Before the vessel is finally floated, all the support afforded by the ways

appreciable time during which the entire weight of the hull rests on a single line of blocks, with a very possible damage to the bottom of the vessel.

Let us again revert to our ship and determine pressures. There will be about 13 blocks in this No. 1 row, of 6 square feet each, or 78 square feet, sustaining a weight of 1,300 tons. This will mean an increase in the pressures to about 16⅔ tons per square foot.

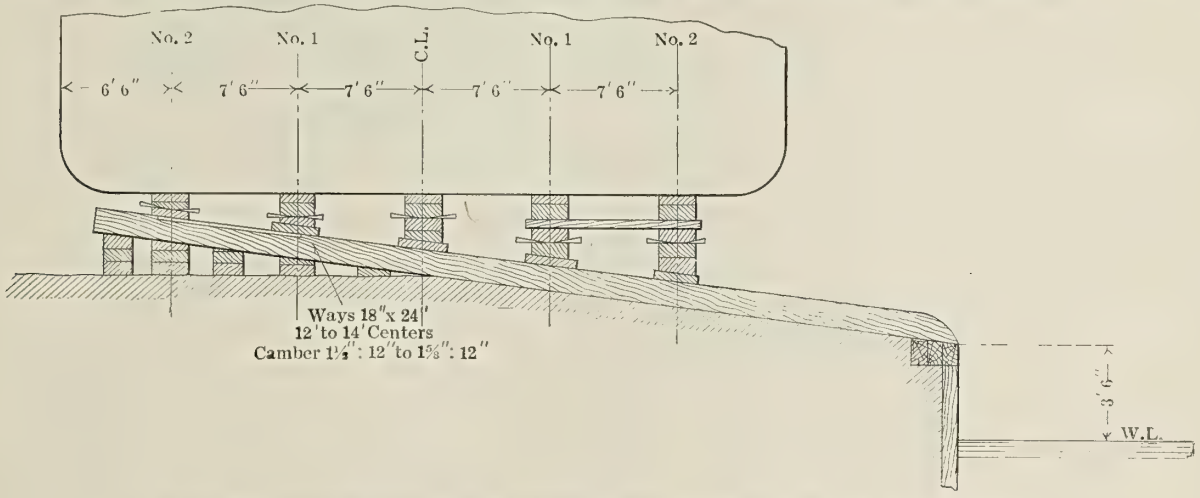


Fig. 1.—Diagram Showing Cross Section of Vessel and Ways Ready for Launching

must be given by one line of blocking. This must, of course, be one of the inshore rows. If the strains are of a lifting character they will finally fall on the No. 2 row, but if of a tipping character, on the No. 1 line.

To determine this point, the calculations must be similar to those of an end launching. It will depend on the relation of the buoyant moments about these two block lines to the weight moments about the same points. To have a lifting condition means excess of buoyant lifting

Between these extreme cases can occur a number of intermediate ones under different conditions of water level, camber, etc. For instance, we can assume that the vessel has already acquired a substantial buoyant moment when she throws the keel blocks and acquires a tipping moment. Any buoyancy obtained before tipping will decrease the total pressure on ways and the pressure per square foot as well. Damage to the bottom need only be expected in cases of large tipping pressures, and its

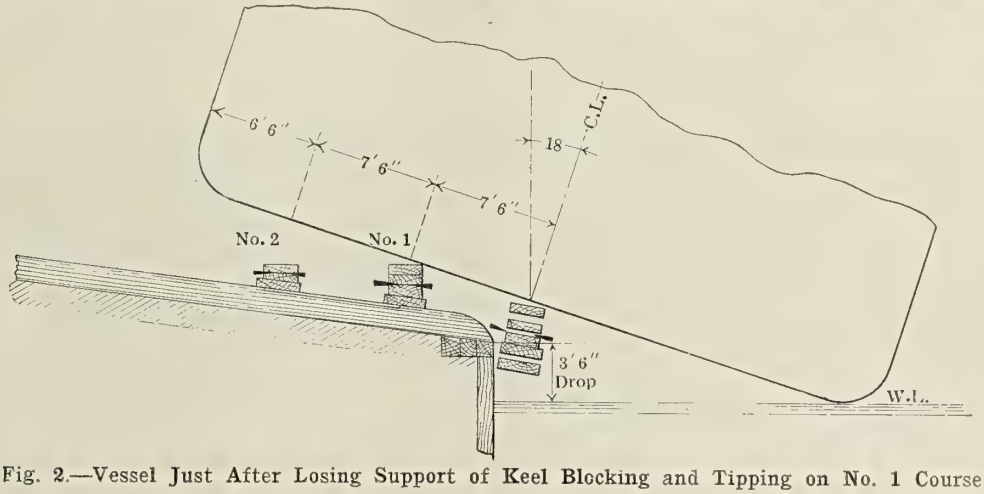


Fig. 2.—Vessel Just After Losing Support of Keel Blocking and Tipping on No. 1 Course

moment, and, generally speaking, this requires ways running under the surface of the water or rapidly increasing camber at the way ends. This also would furnish the safest conditions to launch under. The land pressures will finally be given by the inshore No. 2 course of blocks and will equal the ship's weight less the buoyancy. The other extreme would be a case where the way ends are so high above the water surface that the hull, while sliding down the ways, throwing the different lines of blocking in succession and increasing the pressures, overbalances after losing the support of the keel blocking and tips on the No. 1 course as an axis, before acquiring any buoyant support. In such a launching there will be an

position can be safely predicted to be in that strake of plating under the No. 1 blocks.

So far the pressures have been calculated on the supposition that the entire bearing surface of the No. 1 blocks remains in contact with the bottom throughout the tipping period. This, of course, is not the case. These blocks will act precisely as the fore poppets of an end launching where no provision, such as soft packing, is made for the large and rapid change of angle. There will be an intense localization of pressure at the outboard edge of these blocks, and the buckles in the bottom shell will be deeper at these points.

Attention was directed earlier to the decrease in the

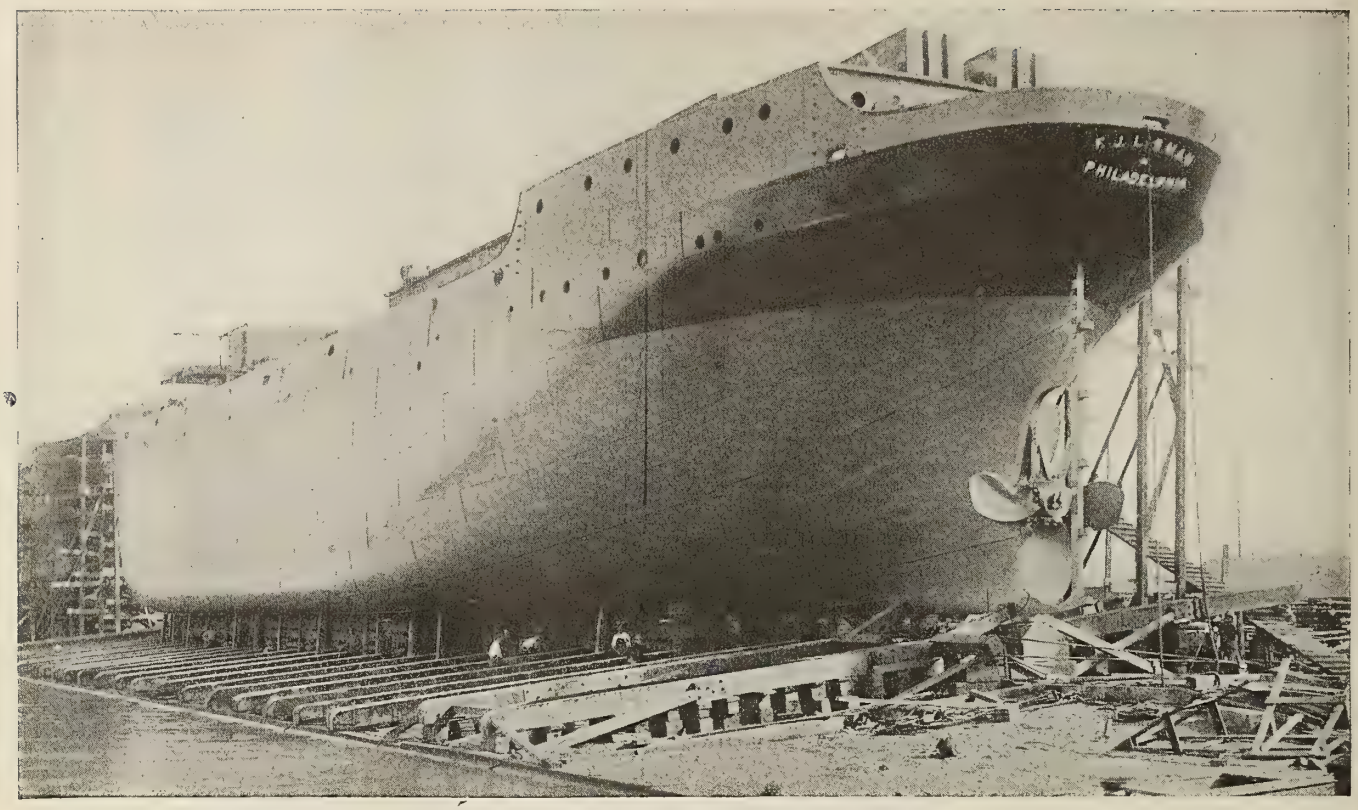
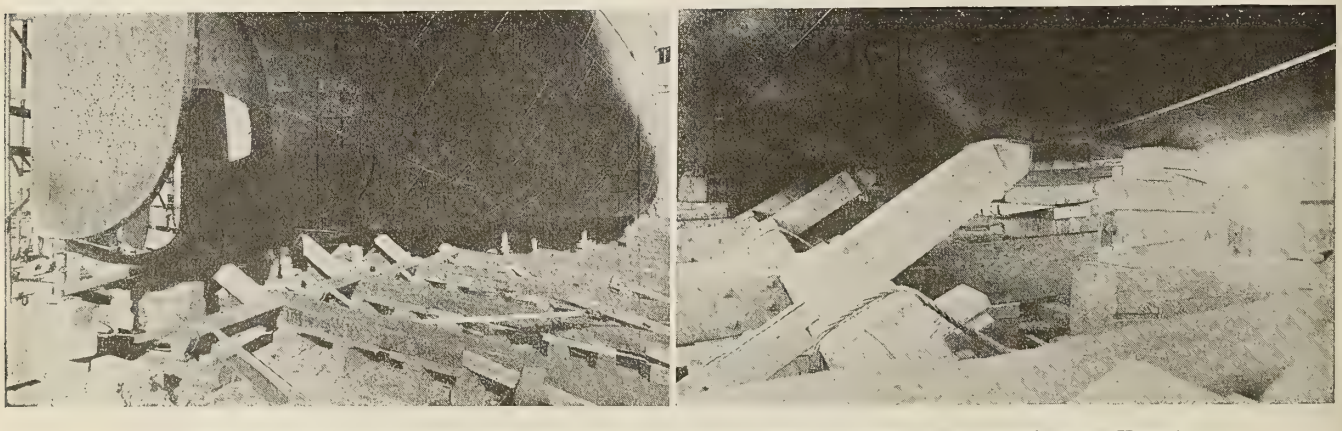


Fig. 3.—Lake Vessel Ready for Side Launching

number of blocks as one went overboard, due to buttock limitations. Under the ship in question there would be about 13 blocks in the important No. 1 course. With the ways on 12-foot centers, this means that the hull is supported for a distance of 150 feet, with an overhanging length of 50 feet at both ends. At the critical moment, the hull would resemble a uniformly loaded beam, uniformly supported for a portion of its length, with overhanging ends. Under these conditions, the hull as a girder being somewhat flexible, there will be a further and severe localization of support at the terminal blocks of the critical row; and when damage occurs it will be found much more severe at these points.

Special care should be taken in launching fine lined ships where extreme cases of tipping are to be expected. And in all cases of tipping it would be well to make provisions for large pressures at these places. One remedy would be a closer spacing of the ways at these points, with a provision for crushing strips at these terminal blocks certainly, and perhaps at all the blocks of the critical row.

Concerning safe pressures, one is naturally reluctant to predict. Where there has been no provision for localization of these, damage has always resulted where the pressures figured statically are 16 tons or over. Whether or not this would occur if special provision were made in the form of crushing strips or in a closer spacing of the ways under the terminal blocks, it would also be unwise to prophesy, but it is believed they could then be safely carried as high as 12 tons per square foot.



Figs. 4 and 5.—Launching Triggers and Dagg ers at Stern and Bow for Releasing the Vessel

While Fig. 1 shows the usual custom of five rows of blocking, some yards have added another row on the inshore side. This extra row will be immaterial in the case of a lifting launch, but cannot be recommended when tipping is to be expected, for the following reasons:

Let the rows be numbered 1, 2 and 3 from keel to bilge. As soon as the keel blocks have passed over the way ends, the hull tips on the No. 1 row, rises clear of the other



Fig. 6.—Method of Cutting Rope to Release Trigger at Side Launching

two rows and leaves these on the ways, unless all the courses are connected together. Later on, when the No. 1 row passes over the way ends, the hull will drop bodily and, having no blocking under her, will hit the ways.

Where vessels have been blocked up in this manner, an examination of the blocking after the launch will reveal that it is more or less chewed up. Moreover, where there is a considerable drop and the three outboard rows are tied together, the drop of the hull is very evident from the way the blocking is thrown about and scattered by the hull landing on these courses while in a listed position.

Fig. 2 shows a vessel just after she has lost the support of the keel blocking and tipped on the No. 1 course. The height of the dock edge above water is 3 feet 6 inches, which, with an 18-inch way, makes a drop of 4 feet 6 inches. This is not an unusual case so far as lake practice is concerned, but it appears that the hull must list to an angle of 18 degrees before it even touches the water. When the dock edge is at the water level, this angle will reduce to about 9 degrees or one-half the previous angle.

Fig. 1 shows the No. 1 course placed midway between the centerline and the outboard courses, on 7-foot 6-inch centers. This is for a ship 43 feet wide and is perhaps general practice. On the placement of these courses it would seem better to increase the distance of the No. 1 row from the centerline rather than diminish it, as this will give more assurance of clearing the ways when the No. 1 course is dropped.

Another circumstance to be avoided as far as possible is that of having any of the double-bottom tanks full at the time of launching. In some cases this may be necessary for the purpose of stability, when special provisions in the blocking must be made. The water should be restricted to those tanks within the fore and aft limits of the critical row of blocking. It is readily seen how the presence of a body of water beyond the terminal blocks will modify the load curve and additionally burden the terminal blocks and contiguous hull.

Inspection of Metallic Electrode Arc Welds

Two Methods of Testing Welds—Haphazard Welding Versus Correct Procedure—Method of Placing Deposited Layers Plays Important Part on Internal Strains

BY O. S. ESCHOLZ*

DETERMINING the character of welded joints is of prime importance, and the lack of a satisfactory method, more than any other factor, has been responsible for the hesitancy encountered among the engineering profession towards the extensive adoption of arc welding. To overcome this prejudicial attitude it is eminently desirable to shape our rapidly accumulating knowledge of operation into an acceptable method of inspection.

Manufactured apparatus is practically all accepted on the basis of complying with a process specification rigidly enforced in conjunction with the successful reaction to certain tests applied to the finished product. Riveting, it is commonly known, seriously impairs the strength of the joined plates, yet with a proper layout and intelligent inspection, the completed structure possesses certain definite characteristics which do not require further verification. The inspector of a finished concrete structure is practically helpless. That the weakest sort of construction may be concealed by a sound surface is quite possible. With a careful supervision of the process, however, the physical properties of the completed structure can be reliably gaged to the extent that its use is justified even in ship construction. With this in view, it is satisfying to realize that electric arc welding is susceptible to even

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better control than either of these structural operations.

How to Determine the Character of a Weld

The four factors which determine the physical characteristics of the metallic electrode arc welds are: fusion, slag content, porosity, and crystal structure.

Some of the other important methods that have been suggested and used for indicating these characteristics are:

(1) Examination of the weld by visual means to determine:

(a) Finish of the surface as an index to workmanship.

(b) Length of deposits, which indicate the frequency of breaking arc, and, therefore, the ability to control the arc.

(c) Uniformity of the deposits, as an indication of the faithfulness with which the filler metal is placed in position.

(d) Fusion of deposited metal to bottom of weld scrap as shown by appearance of under side of welded joint.

(e) Predominance of surface porosity and slag.

(2) The edges of the deposited layers chipped with a cold chisel or calking tool to determine the relative adhesion of deposit.

(3) Penetration tests to indicate the linked unfused zones, slag pockets and porosity by:

(a) X-ray penetration.

(b) Rate of gas penetration.

(c) Rate of liquid penetration.

(4) Electrical tests (as a result of incomplete fusion, slag inclusions and porosity), showing variations in:

(a) Electrical conductivity.

(b) Magnetic induction.

These tests if used to the best advantage would involve their application to each layer of deposited metal as well as to the finished weld. This, excepting in unusual instances, would not be required by commercial practice in which a prescribing welding process is carried out.

Of the above methods the visual examination is of more importance than generally admitted. Together with it, the chipping and calking tests are of particular usefulness. The latter test serves to indicate gross neglect by the operator of the cardinal welding principles, due to the fact that only a very poor joint will respond to the tests.

Penetration Tests

The most reliable indication of the soundness of the weld is offered by the penetration tests. Obviously, the presence of unfused oxide surfaces, slag deposits and blow holes will offer a varying degree of penetration. Excellent results in the testing of small samples are made possible by the use of the X-ray. However, due to the nature of the apparatus, the amount of time required and the difficulty of manipulating and interpreting results, it can hardly be considered at the present time as a successful means to be used on the large-scale production.

The rate that hydrogen or air leaks through a joint from pressure above atmospheric to atmospheric, or from atmospheric to partial vacuum, can readily be determined by equipment which would be quite cumbersome, and the slight advantage over liquid penetration in time reduction is not of sufficient importance to warrant consideration for most welds.

Kerosene (paraffin), of the various liquids that may be applied, has marked advantages, due to its availability, low volatility and high surface tension. Due to the latter characteristics, kerosene (paraffin) sprayed on a weld surface is rapidly drawn into any capillaries produced by incomplete fusion between deposited metal and weld scarf, or between succeeding deposits, slag inclusions, gas pockets, etc., penetrating through the weld and showing the existence of an unsatisfactory structure by a stain on the emerging side. A bright red stain can be produced by dissolving suitable oil soluble dyes in the kerosene (paraffin). By the means of this test, the presence of faults have been found that could not be detected with hydraulic pressure or other methods. By the kerosene (paraffin) penetration, a sequence of imperfect structures linked through the weld, which presents the greatest hazard in welded joints, could be immediately located. It must be borne in mind, however, that this method is not applicable to the detection of isolated slag or gas pockets, nor small, disconnected unfused areas. It has been shown by various tests, however, that a weld may contain a considerable amount of distributed small imperfections, without affecting, to a great extent, its characteristics.

If a bad fault is betrayed by the kerosene (paraffin) test, it is advisable to burn out the metal with a carbon arc before rewelding under proper supervision. By the means of sand blast, steam, gasoline (petrol), etc., large quantities of kerosene (paraffin) are preferably removed. No difficulty, however, has been encountered on welding over a thin film of the liquid.

Electrical Test Methods

Electrical test methods, by which the homogeneity of welds is determined, are still in the evolutionary stages. Obvious difficulties are yet to be overcome before the electrical test is feasible. Some of the difficulties are the elimination of the effect of contact differences, the influence of neighboring paths and fields, and the lack of practicable, portable instruments of sufficient sensitivity for the detection of slight variations in conductivity or magnetic field intensity. No simple tests are possible, excepting those which involve subjecting the metal to excessive stresses, for determining the crystal structure. Control of this phase must be determined by the experience obtained from following a prescribed process.

The inspection of metallic arc electrode welds may consider that through the proper use of visual, chipping and penetration tests a more definite appraisal of the finished joint may be secured than is possible in either riveting or concrete construction. The operation may be still further safeguarded by requiring rigid adherence to a specified process.

Good Results Are Assured if Correct Procedure is Followed

Haphazard welding can no sooner produce an acceptable product than hit-or-miss weaving will make a marketable cloth. It is only logical that all the steps in a manufacturing operation should be regulated so as to obtain the best possible result. As it is, and most unfortunately, most welders consider themselves pioneers in an unknown art that requires the exercise of a peculiar temperament for its successful evolution. As the result, welding operators enshroud themselves in the hallow glow of an expert, do their work with a mysterious camouflage bewildering to the untutored. Once in a while, due to, we might say, coincidences, these "experts" are successful in obtaining a good weld, but more often the good weld is attributable to the friction between slightly fused, plastered deposits.

In common with all other operations, metallic electrode arc welding is really susceptible to analysis. Regardless of the metal welded with the arc, the cardinal steps are: (1) Preparation of weld; (2) electrode selection; (3) arc current adjustment; (4) arc length maintenance; (5) heat treatment.

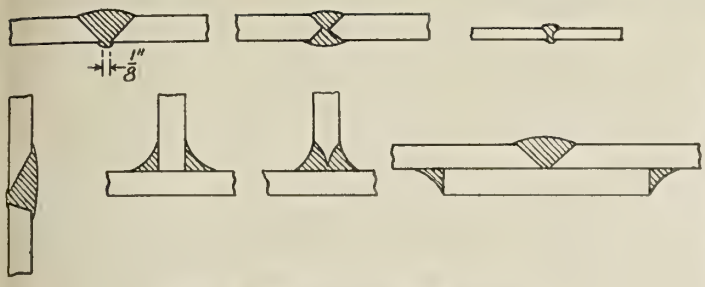


Fig. 1.—Typical Arc Weld Scarfs

Sufficient scarfing is involved in the preparation of the weld, as well as the separation of the weld slants, so that the entire surface is accessible to the operator with a minimum amount of filling required. When necessary to avoid distortion and internal stresses due to unequal expansion and contraction strains, the metal is preheated or placed so as to permit the necessary movement to occur. Various types of scarfs in common use are shown in Fig. 1.

The electrode selection is determined by the mass, thickness and the constitution of the material to be welded. An electrode free from impurities and containing about 17 percent carbon and 5 percent manganese, has been found generally satisfactory for welding low and high carbon, as well as alloy steels. This electrode can also be used for cast iron and malleable iron welding, although more dependable results, having a higher degree of consistency and permitting machining of welded sections, can be obtained by brazing, using a copper aluminum iron alloy electrode with the aid of some simple flux. Successful results are obtained by brazing copper and brass with this electrode. The diameter of the electrode should be chosen with reference to the arc current used.

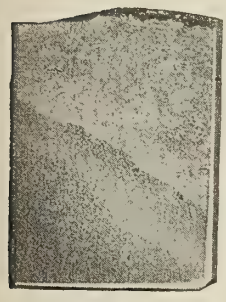


Fig. 2



Fig. 3

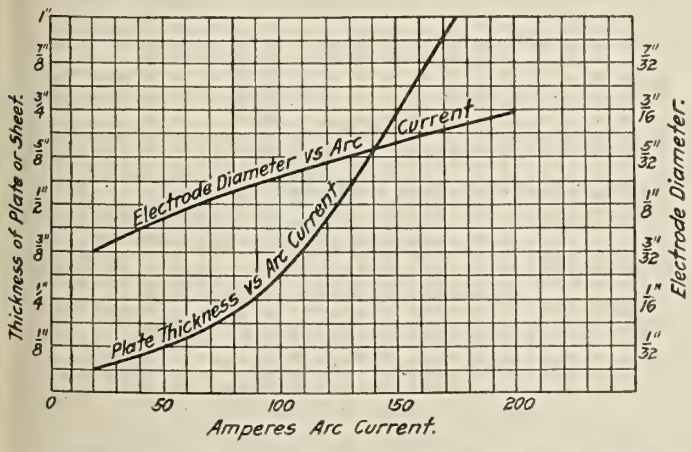


Fig. 4.—Chart Showing Approximate Arc Current and Electrode Diameters for Welding Steel Plate of Various Thicknesses

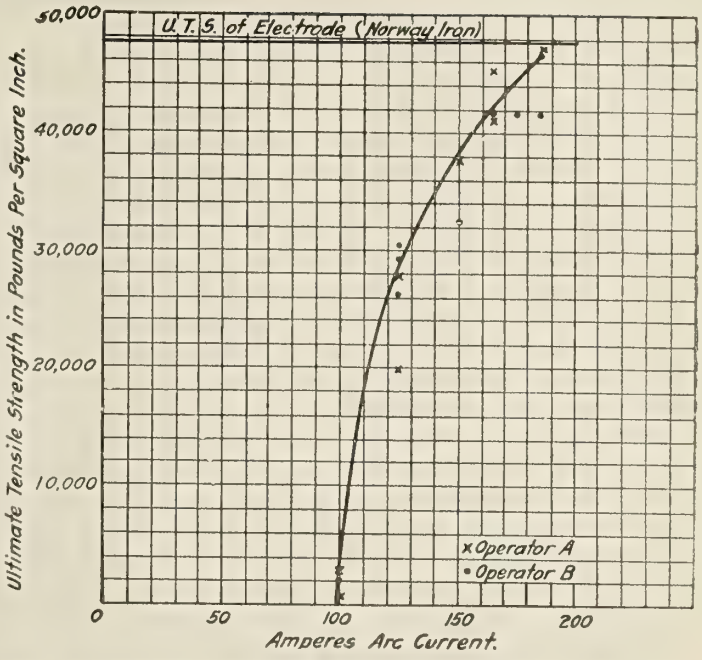


Fig. 5.—Variation in Weld Strength With Change in Arc Current

The Effect of Too Low Current Values

A great many concerns have attempted welding with too low an arc current, and the result has been a poorly fused deposit. This is due largely to the overheating characteristics of most electrode holders, on using current value, and thus leading the operator to come to the conclusion that the current used is in excess of the amount needed.

Fig. 2 shows a section through one-half of an exposed joint welded with the proper current, while Fig. 3 shows the effects of too low a current. The homogeneity and the good fusion of the one may be contrasted with the porosity and the poor fusion of the latter. (These surfaces have been etched to show the character of the metal and the welded zone.)

The approximate values of arc current to be used for given thickness of mild steel plate, as well as the electrode diameter for a given arc current, may be taken from

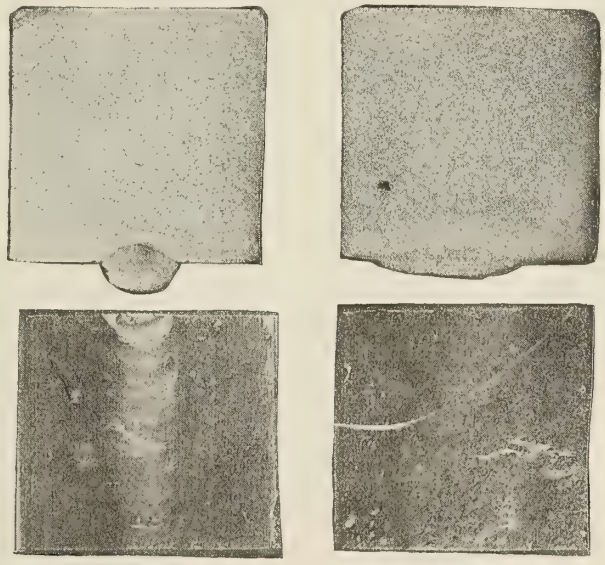


Fig. 6

Fig. 7

the curve in Fig. 4. The variation in the strength of 1-inch square welded joints as the welding current is increased is shown in Fig. 5.

Notwithstanding that the electrode development is still in its infancy, the electrodes available are giving quite satisfactory results. However, considerable strides can yet be made (with its further evolution) in the ductility of welds, consistency in results, as well as in the ease of utilizing the process.

The maintenance of a short arc length is imperative. A non-porous, compact, homogeneous, fused deposit on a 1-inch square bar from a short arc is shown in Fig. 6, while in Fig. 7 is shown a porous, diffused deposit from a long arc. A short arc is usually maintained by a skillful operator, as the work is thereby expedited, less electrode material wasted, and a better weld obtained, due to improved fusion, decreased slag content, and porosity. On observing the arc current and arc voltage by meter deflection or from the trace of recording instruments, the inspector has a continual record of the most important factors which affect weld strength, ductility, fusion, porosity, etc. By the use of a fixed series resistance and an automatic time lag reset switch across the arc it is possible to fix definitely both the arc current and the arc voltage, and thus placing these important factors entirely beyond the control of the welder and under the direction of the more competent supervisor.

The method of placing the deposited layers plays an important part on the internal strains and distortion obtained on contraction. It is possible that part of these strains could be relieved by preheating and annealing, as well as by the allowance made in preparation for the movement of the metal.

Heat Treatment and Inspections

The heat treatment of a completed weld is not a necessity, particularly if it has been preheated for preparation and then subjected to partial annealing. A uniform annealing of the structure is desirable, even in the welding of the small sections of alloy and high carbon steels, if it is to be machined or subjected to heavy vibratory stresses.

The inspector, in addition to applying the above tests to the completed joint and effectively supervising the process, can readily assure himself of the competency of any operator by the submission of sample welds to ductility and tensile tests or by simply observing the surface exposed on cutting through the fused zone, grinding its face and etching with a solution of 1 part concentrated nitric acid in 10 parts water.

It is confidently assumed, in view of the many resources at the disposal of the welding inspector, that this method of obtaining joints will rapidly attain successful recognition as a dependable operation to be used in structural engineering.

Internal Bossing for Cargo Vessels

Structural Changes Proposed Where Strength and Savings in Space and Cost are of Vital Importance

BY E. DE BRINJA

DURING the war the shipbuilding here and abroad took a remarkable step forward so far as output, efficiency and new designs were concerned. Experiments were made on unsinkable ships, concrete boats, ships having cruiser sterns, and on twin-screw cargo vessels.

The bossing used on twin- and quadruple-screw steamers and motorships, however, did not change to any appreciable extent. This fact does not necessarily indicate that improvements cannot be made in design which will save space, labor and money. As a matter of fact, quite a lot of study has been devoted to the development of the matter, and some of the changes proposed in ship bossing are incorporated in the accompanying sketches. These sketches give a general idea of the bossing for cargo ships, where strength, space and money savings are the most important factors to be considered. Of course certain structural parts, such as fastening castings to bulkheads, frames and shells, will alter somewhat according to local conditions.

Before we discuss proposed changes, let us consider the present outside bossing, the material used and labor expended before it may be fitted on the ship. The table below indicates the material used and shops where it is put in shape for use:

Material	Shops	
Hull connection casting	Pattern shop, Foundry, Machine shop	Hull drawing room, Engine drawing room
Stuffing box casting	Pattern shop, Foundry, Machine shop	Hull drawing room, Engine drawing room
Pipe for connecting both castings	Pipe shop	Hull drawing room, Engine drawing room
Bossed frames	Mold loft, Smith shop	Hull drawing room, Engine drawing room
Bossed shell plate	Mold loft, Plate shop	Hull drawing room, Engine drawing room
Fairwater plates	Mold loft, Plate shop	Hull drawing room, Engine drawing room

By the foregoing table it will be noted that six pieces are used to build up the present bossing and that the material has to go through fifteen shops before it is ready to be fitted on the ship. Now let us compare the proposed bossing with this:

Material	Shops
Casting	Hull drawing room, Engine drawing room, Mold loft, Pattern shop, Foundry, Machine shop

Only one fitting is used, and a very remarkable saving of time, labor and expense is apparent.

The brackets used come out with the frames, so that these do not have to be considered.

Naturally there are other points to be considered in addition to those given above:

Is this a strong construction?

Is there enough bearing surface?

Is the proposed construction sufficiently light?

Is the distance between the strut arm and the bossing too great?

What effect on eddy-making will the shaft have where it leaves the hull?

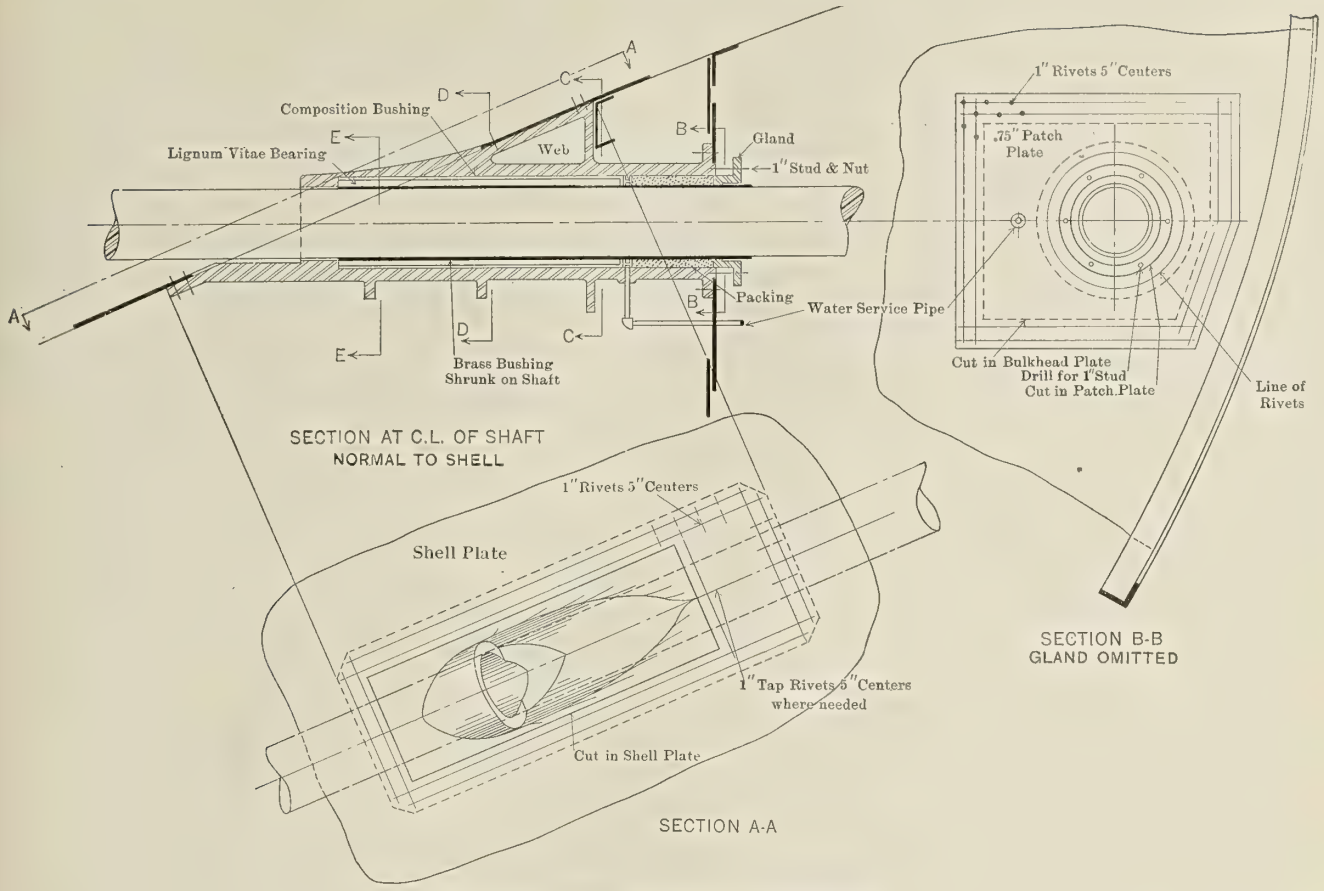


Fig. 1.—Changes Proposed in Ship Bossing

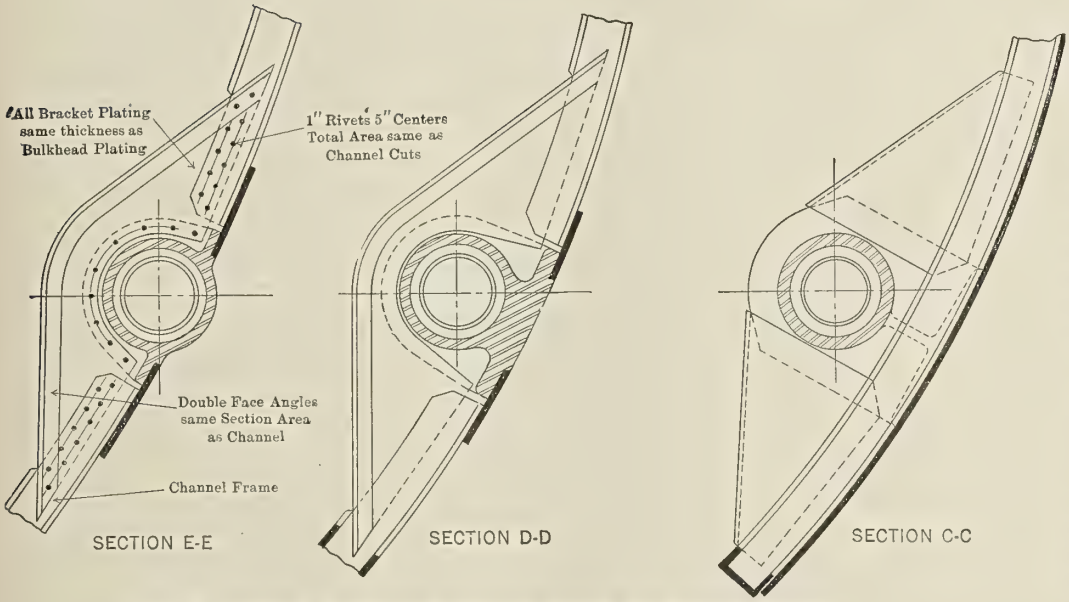


Fig. 2.—Sections Showing Structural Details of Internal Bossing

How much lost cargo space is caused by this construction?

As we investigate these questions we find that the construction will be stronger, as the connection of the casting to the hull, frames, bulkheads, etc., is on the inside of the vessel and may be reinforced to suit conditions. Webs in the casting, brackets, angles and plates may be used freely without having to look out for eddy-making or any other kind of resistance.

The bearing surface may be made as large as desired—about four diameters of the shaft plus the length of the stuffing box.

It must be evident to all that the weight of the proposed bossing will be less than the outside bossing, inasmuch as it consists of only one casting and a few brackets, while the other includes two separate castings, a tube, fairwater plates and bossed frames.

The length of unsupported shafting between the bossing and the strut arm will be found to be safe, if the distance is not greater than 30 diameters of the shaft, which is very seldom the case in cargo vessels with block coefficient of 0.74, or at least over 0.70.

The eddy-making and residuary resistance is practically negligible, as the hull is fair and the shaft round, and no fairwater plates are needed. The wetted surface is also slightly decreased.

The cargo space lost is less than in the present construction, as the entire casting of the internal bossing is only about as large as the casting connecting the outside bossing to the hull.

The casting is made of steel with webs and flanges, sufficiently strong to stand the strain. Its thickness, of course, depends on the size of the ship and the horsepower.

One continuous frame is fitted to the casting by means of staunch brackets (Section C-C), while in places where frames are cut, solid brackets with double-face angles are fitted, riveted to the frames and flange of the casting.

The smallest sectional area through the bracket and face angles must be at least as great as the area of the frame, and sufficient rivet area should be given (Section D-D and E-E).

The cut in shell plating may be altered to suit conditions, but the casting should be recessed to take the shell plating. The latter is chain-riveted to the casting (Section A-A).

A heavy patch plate is fitted on the bulkhead, to which the casting is riveted. Sufficient space should be left between the shell and the patch plate to allow for calking. Means of access is provided in the bulkhead so the casting may be removed without cutting the bulkhead.

Minor details, as the stuffing box, water service, bearings and bushings, will be the same as practiced now.

This bossing should prove to be useful in the construction of cargo ships and "full" passenger steamers of the future. The term "full" is used advisedly because in a "fine" line steamer the distance of unsupported shaft might be too great and an additional shaft arm would have to be fitted. This method, of course, would lose the advantage of labor and money saving that we have tried to accomplish with the new bossing.

The primary object of this design is to lower the cost per ton, which is so high now, without affecting the quality, strength and workmanship of the construction.

Sequence of Mold Work in the Loft

System Adopted at the McDougall-Duluth Shipyard for Getting Out Material for Standard Lake Type Cargo Steamers

BY J. A. RIDLEY*

THE following is a programme arranged at the McDougall-Duluth shipyard by the writer a year ago to handle the mold loft work in getting out the single-deck type of standard cargo steamers as built in various yards on the Great Lakes. It was arranged with a view of bringing into simple routine the many items involved (where the whole hull is made from the loft) in their regular order to suit fabrication and erection. While certain conditions made it impossible to follow the programme exactly, nevertheless it proved useful, and may be of interest to those having similar jobs to do.

Briefly, the first operation was fairing up the lines, which has so often been explained, then lifting finished offsets on sheets of paper to transfer them onto the body plan so as to scratch in all the transverse frames. The body plan must be very well prepared in this case and every item carefully spotted in with paint, which proves an economy of time before completion of the whole job.

The Body Plan

On the body plan (always termed scrieve board in England) mark all the plate edges with the sight edge prominent, including all the cut off at the top of the bulwarks to the extreme ends of the ship, also all decks or flats, stringers, floor heights, tank margins and brackets, sections of side and center keelsons and girders, sections of casings, deck houses, coal chutes, hatches, boiler stools, engine girders and beam cambers at bulkheads and intermediate parts a few inches apart, using the beam mold made at this time.

Next lay off the cant frames and clearly scratch and paint in their projections on the body plan. Also spot paint all the extremes, as stem and stern post contour lines, a short distance at the stern and stem on the main floor. The clear marking and inclusion of all these fixed items minimizes the chance of error or neglect in taking care of connections to each other. This immediately establishes the outlines, and time and mental efforts are saved in a reduction of continual reference to other drawings.

In mold work it is necessary to start on the keel and center vertical keelson at the same time with the angles, excepting the flange to the tank top; in fact, many of the dead flat molds could be well under way using the midship frame only. Finish the keel to the extreme ends with molds and forms to bend the same, and also the center keelson with the termination brackets, and finish all clips to same throughout. Carry along the dead flat bottom shell first, and if you get an early start, finish expanding the whole of the shell. The exact position of all the land holes will then be secured so that it will be possible to get every hole in the frames and its correct line on the stem and stern frame for landing the scarph and tuck molds, and to have a chance to revise the shell orders to eliminate errors and scrap.

In any loft it is a good plan to lift all shell records for expansion from the body plan, either on strips carefully stored and indexed, or, better, in dimensions on a loose-leaf record book, with every necessary particular in tabular form at one operation, so that it will be possible to go apart anywhere to develop the shell clear of the body plan, and enable frames and other numerous particulars to proceed without interruption. Make an early start on the smith molds for the bilge floor frames and mark the bevels, also molds with all the holes in for marking the stern post, tuck plate and stem. Make your efforts tend to produce at an early stage of the work all that affects the installation of machinery, which will also increase the speed of launching and delivery of the ship.

To avoid a long cluttering up of the floor, start a separate arranging of flange strips for the tank top stiffeners, center keelson intercostals, boiler stools, engine foundation, tunnel and shaft stools and other tank top connections. It is not a bad plan, with a scarcity of floor space, to make a longitudinal strip arranged for butts that can be used right across on the tank top edge laps to avoid laying down a monopoly of large pieces.

Laying Out Tank Top Connections

With the floor molds made, it is possible to finish the tank top stiffeners, top angles of the center keelson, intercostal side girder margin clips both square and with bends. Take care of the special gage for the latter, and angle collars to watertight floors. Lay out all tank top plating, using the aforesaid strips, and also the margins connecting thereto in conjunction with the above. If the shell is

* Inspector, Emergency Fleet Corporation.

finished, the margin angles can also be finished, leaving short blank pieces to drill outside where the three ply at crossing shell laps occur. Make smith molds for the upper bilge angles and mark the bevels on them. Then continue with the side frames, starting at midships, and fix universal holes for the beam brackets, bilge brackets or other connections and bevels, and complete the bilge brackets with the frames ready to mark off, leaving the beam brackets until later. Gather tank connections of boiler stools, engine and thrust foundations, shaft tunnel and stools and recesses, mast and pillar brackets, all auxiliary foundations and lay out and finish molds for these items completely, finishing all angles on the tank for early testing of compartments affecting the installation of machinery. Lay out and complete molds for all internal bulkheads, including the bunkers and angles connected thereto, except deck flanges. Lay off and template all panting stringers, web frames and swash plates, lower flats, chain lockers, beams and pillars below the main deck, deck runners and girders and other such internal items.

Get out molds for the strong beams early, including the hatch end plates, and hatch coamings with all connections. Start a separate arranging of beam strips midships for the main deck. Sometimes it is best to expand the whole thing on the floor temporarily and arrange the butts of plates, etc., and record the whole on the above strips, and the new expanded stations with butt positions, etc., on longitudinal strips to enable the decks to be layed out later in less portions without such monopoly of floor space. This, of course, is dependent on time, and quantity of help, with floor space. With the strips ready it is now possible to finish the beams and the bulkhead bounding angles at the deck flange. It is advisable to keep the rivets universal gage on both beam and frame for the bracket knee (except at the ends of the ship) and use a bracket hinged on a small rivet at the corner of the deck and skin, and carry this along, marking the change of each beam in the throat or diagonal knee, while holding it to the camber line and frame line. This could be used to lay out the plate knees direct, but later these bracket molds are made of millboard on a bench for outside use, while the other is kept as a record.

Use of Millboard Molds

Millboard is handy for many purposes—as cut-up intercostals, deck girders, partial floors, bilge brackets and all small brackets. Some kinds of millboard can be drilled easily and used just as template wood, which saves much labor. The thinner paper, however, is unsatisfactory. The frames will be nearly finished by this time, so it will be possible to gather the deck strips and lay out all the molds for the main deck stringers and deck plates and fix up the gunwale angles having the shell flange from the plating, also scupper compensation angles and brackets to deck.

Pick up all strips or flanges which have already been laid out and make molds for the engine and boiler casings, first transversely then longitudinally; also coal chutes connecting the same and all hatch coamings, deep under-deck girders, diamond plates, mast brackets, winch flats and foundations, and also the masts with all their attachments, and hold pillars and finish all braces and angles. Lay off all cant molds and fix all bracket and clip connections and follow with expanded and molded counter plates, if not already done in connection with the shell.

The writer finds it best to do these in the way he used twenty-five years ago in England when using drilled templates and to adjust the knuckle to the rail both ways as far as needed, if there is only slight change in the offsets, and use the old quick and true set line method. Lay out molds for all weather deck or superstructure bulkheads, using shell flange strips and deck flange strips to complete all angles for the same. The ventilators should also have been included earlier. In some circular ones it is best to drill flange holes through the deck when placed. Every item on steel doors is also laid out in the loft, such as dogs, slots and hinges punched small to bolt up, adjust and ream.

Prepare strips as before for the bridge, poop and forecastle decks and all deck house and such connections. Scratch the outline of the two endmost decks on the floor and spot paint, then finish all beams and brackets and make molds for all these decks, being careful to include all fittings which have been approved sufficiently to be located at that time, and finish all gunwale and other angles to these decks.

Where there are many hulls off the molds, it will be a good plan carefully to develop the hawse pipe, to get the complete mold from the lines, and also the exact finished size of the holes in both shell and deck for its easy insertion. The most accurate pattern is thereby obtained to fit the many ships. The writer had almost a monopoly in low cost, in replacing broken hawse pipes at Grimsby twelve years ago, and has done many on this continent in addition to anchor pockets in the old way with rod and gage. This is mentioned because the writer feels that many will protest that the above development is impracticable, but in a tangible process clearly understood it takes little time to develop a multitude of lines.

Expand the bulwark rails and lay off molds checking with the shell connection, also the end brackets at bulkhead, and the bulwark stays laid off and molded to position in the body plan. They will correct the rail, with one part small holes bolted, adjusted and reamed. Gather all connection strips and lay off and mold all deck houses on the bridge and also poop deck and boat deck and all beams, stiffeners, brackets and steel doors as previously described. Finish all these to the entire top of the superstructure. Lay out molds to plates in the skylights for galley and engine room, and all their angles and connections.

The steel crosstrees on the mast head can be molded entirely in sections using millboard, and all the molds made for the fresh water tanks, which will about finish the job. This programme was carried out almost in the order named, odd things as usual in shipbuilding were delayed, pending approval, but generally included later. The hawse pipe production seemed deliberately obstructed in approval until too late to be included, although there could have been less error than previously, or less division of responsibility with a definite person to blame.

The shell was almost complete out to the extremes, and where many hulls are built from one set of molds it seems best, after all, to do the most difficult plates from the loft with forms containing a duplicate of the frame holes to pin plates and fasten to exact position at the slab. Such plates are costly to lift and set at the ship, and often have finally to be formed from the loft.

Standardized Marking of Molds

We always aimed at simplifying the billing or marking of molds, by abbreviations and omissions, standardized as far as possible. This was a habit formed in a short period of structural work, which, though better in some ways, is not so cheap in the whole as shipwork. The hull number was billed first, then the particular part of the hull next in exactness, following with the item number in the

stock sheet, quantity of plates or angles to mark therefrom with poundage and which side up to mark, diameter of holes and particulars of countersinking. While this appears lengthy in description, it only comprises a few letters and symbols, which are kept in one place and do not have to be hunted up all over the template. For example,

Hull No. 14 Shell L-5
1.64 = 1*PL* = 22.8 pounds *T-S-U* = *S*
1.64 = 1*PL* = 22.8 pounds *O-S-U* = *P*
⅞ o Csk. O,

which means hull number 14, on shell the L strake number 5 plate, use stock sheet item number 64, take 1 plate equal 22.8 pounds' weight and mark it with mold this side up for starboard side and the other side up for port side and punch on marks with ⅞-inch holes, and in each case countersink when turned over and inside of these outlines.

Further, all holes were drilled in both wood and paper of constant size ½-inch clear, so that one size punch would mark everywhere. The small holes preserve the strength.

An attempt was also made to keep a record of their use in the yard with dates, and (another very important point) some effort was made at having a proper tallied storage in the loft, with a system of divisions like plate racks for the different strakes of shell, and other distinct sectional parts, not including more in divisions than was easily available for constant reference, in the many connections necessary in this system, which all saves time, gives an easy check to reduce the chances of error and tends to produce success.

Shipping Board Engineers Study Marine Turbine Construction and Operation

Westinghouse Company Conducts School at East Pittsburg—250 Students Take Intensive Six Weeks' Course—Engineers at Sea Given Advice on Operating Problems

WHEN the United States Shipping Board began to operate cargo vessels the want of properly trained officers proved a decided handicap. This was particularly true of the propelling machinery staff, for not only were reciprocating engineers needed in large numbers, but men familiar with the geared turbine drive.

The opening of the turbine schools, where skilled engineers, who had been trained on reciprocating engines, or had in some cases limited experience in the handling of turbines, could be given the latest and most improved instruction under the direction of men thoroughly familiar with the construction and assembling of this type of engine, was immediately considered.

Turbine School Opened

The Board communicated with the leading manufacturers of turbines (Westinghouse, General Electric, De Laval, Kerr, and others) and proposed that classes be established at each plant for engineers who would be supplied by the Shipping Board. The first class was opened in 1918 at the Westinghouse works in East Pittsburgh.

The school was under the official direction of the Board's recruiting service. After the school had been in existence a short time it was placed under the direction of A. A. Gathemann, supervising engineer of turbine training United States Shipping Board recruiting service, who deserves unlimited credit for making this undertaking a decided success.

The students in these schools must be either chief engineers or first assistants. Many candidates applied direct to the recruiting service; others are selected from their staffs by the various ship operating companies; and still others are picked up individually by the recruiting service and turbine manufacturers, either because of personal acquaintance or through correspondence requesting information as to turbine operation.



Fig. 1.—U. S. Shipping Board Marine Engineers Class No. 8. (Back) Sadler, Schloetzer, Field, Frazer, Thornton, McIntire, Sheppard, Tegtmeir, Stewart, Brinkman. (Front) Rattner, Standish, Harleston, Lloyd, Simons, Byrne, Callahan, Roche, Norton, Harrison

During the course of instruction, which averages about six weeks in length, the students receive liberal shore pay, traveling expenses and an allowance for sustenance. Upon completion of the course, if the student has attained a satisfactory average for all work done, he is awarded a diploma which, although it has no official status, is ample evidence that the holder is qualified to operate marine turbines. Over 250 students have so far been enrolled.

The principal schools are located at the plants of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, and the General Electric Company, Schenectady. All students must take the courses at both of these schools. Afterward those who are to handle some other make of turbine in the immediate future are transferred to the plant of that particular manufacturer.

The Westinghouse Company has developed a very comprehensive course. A. W. Kirton, who is in charge of the

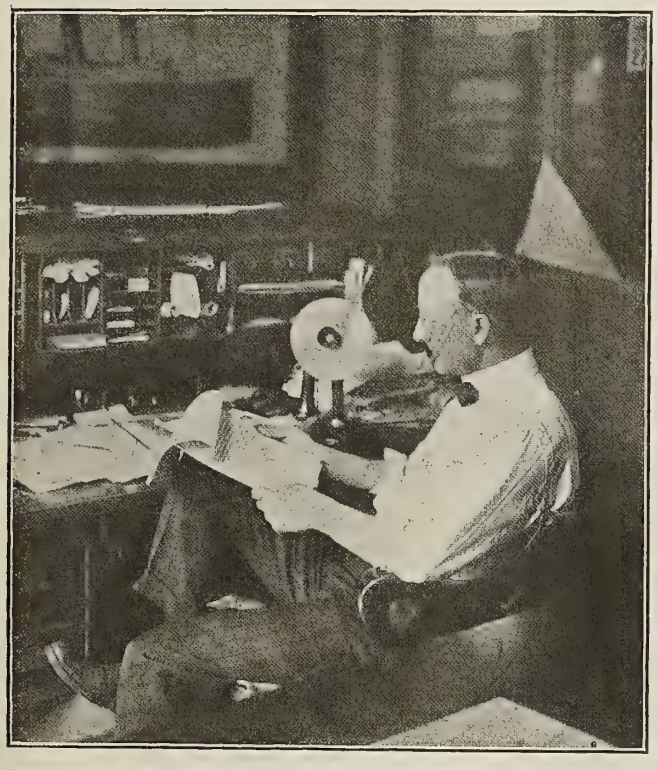


Fig. 2.—A. W. Kirton, in Charge of Westinghouse Marine Turbine School

local school, has been connected with the company for more than twenty years, and has had charge of large foreign contracts in South Africa, Russia and Brazil. Officially he is in charge of the contract inspector's department, handling all visiting inspectors and their contract relations with the company.

Course of Instruction

The course, which runs through a period of three weeks, is divided into five main subjects: Small turbine drives; condensers and auxiliaries; main turbine; main reduction gears; and electrical equipment.

The class is taken into the shop, in groups of not more than seven or eight to each instructor, and given the opportunity of seeing all the parts of each piece of the various propelling apparatus. Each part is carefully and systematically explained in detail. Great care is taken to explain the reasons of design, where trouble may occur, and how to remedy it. The class is also given every opportunity for taking each piece of apparatus apart and reerecting it, to make sure that each man has a thorough understanding of the construction. The men also go over

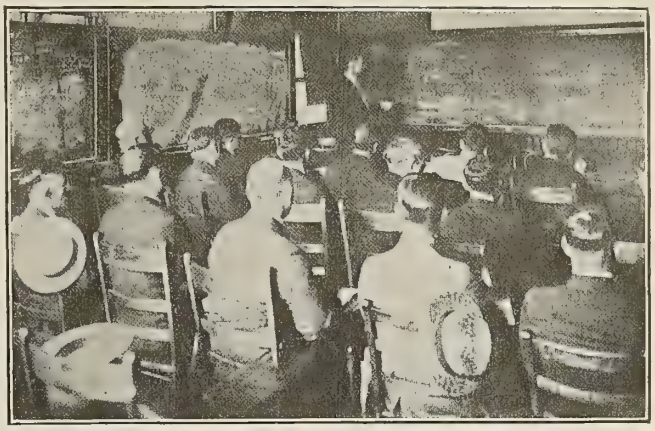


Fig. 3.—Attending a Lecture

all adjustments on the turbines, and do sufficient work on the inserting of turbine blades to know what to do in case of trouble. On the main gears, great care is taken to make the class familiar with all adjustments necessary for alining and operation.

Supplementing this training, lectures are given on each of the above groups by Westinghouse engineers. Practical points of operation are emphasized and fundamental principles brought out. The class is encouraged to ask questions during the lectures.

After the specified time allotted to each subject has expired, examination questions on that subject are given out and written answers handed in. The corrected examination paper is handed back to each student, together with a copy of the correct answers. The students appreciate this method exceedingly, since it gives them a chance of seeing where they are wrong and, by keeping all the official questions and answers together, they have an excellent reference book for future use. Time is provided for reviewing work that is not clearly understood by any student.

The following typical questions picked at random from the various examination papers will show the scope of the course offered:

Why is the diaphragm used between the ahead reaction blades and the astern blading on the high pressure turbine?

Why is it not used on the low pressure turbine nor on the single-cylinder complete expansion turbine?

Why is the balance piston or dummy used?

Describe how you would take blade clearance, stating



Fig. 4.—Practical Work With a Turbine Spindle

each move from beginning to take turbine apart to final assembly ready for operation.

Give detailed description of starting and stopping the condensing equipment.

State the different methods of measuring a vacuum.

When the course is completed the student's record is forwarded to the Shipping Board, serving as a true analysis of the student's aptitude and probable ability, which is very useful in finally placing him.

In addition, a grand average is taken of the individual rating, and is known as the "class rating." Rivalry is developed between the classes, which tends to bring out the best efforts of every man.

Personnel of the Classes

The average class consists of sixteen men, usually ranging from 24 to 50 years of age. The men bring to the manufacturing company years of sea experience, and at times give valuable suggestions to the company's engineers. They keep the company's engineers on the alert to answer their very practical questions. Anxious to learn the how and why of the apparatus from the inside, these men make ideal students.

Consultation Encouraged

Every effort is made by the company to impress on all the engineers before leaving that they must not consider their connection with the company severed at the end of their training. They are informed that the company's erection department will keep in touch with them on the ships and give them all the help possible. The men are also invited to visit the works again to keep themselves up to date on all new designs, etc., and are especially asked to keep in touch with Mr. Kirton regarding any engineering problems that may develop on board their ships. Each problem submitted is carefully considered by the company's engineers, and the proper information sent back as soon as possible. Already a number of concrete examples are on file in which the ship engineer has made the operation of his vessel successful by such direct appeal to the manufacturing company.

It is decidedly satisfactory to a chief engineer, thrown on his own resources at sea, to know his apparatus thoroughly, both as to manufacture and assembly. It is equally satisfactory to the manufacturer of the equipment to know that the engineer knows. The combination represents the greatest forward step in satisfactory navigation since the adoption of geared turbine drive on ships.

Proposed Harbor Development at Mobile

IN a preliminary report submitted by William T. Donnelly, consulting engineer, 17 Battery Place, New York, to the State Harbor Commission, Mobile, Ala., important changes in the development of adequate harbor facilities are suggested.

In preparing this outline Mr. Donnelly has made a comparative study of the successful harbors on the Atlantic coast showing that most of the important seaports have grown up as outlets to the natural resources found in the Appalachian mountains. He points out that the southern Appalachian district has only recently been opened for exploitation and consequently that the cities which will develop as the result of this trade are destined for phenomenal growth. He also pointed out that the city of Mobile is the natural outlet for the coal and steel industries in this region and that immediate steps should, therefore, be taken to provide the necessary terminals so that this trade will not be diverted.

The first step toward the adequate handling of freight at this port, Mr. Donnelly said, would be the relocation of the Louisville and Nashville Railroad at a sufficient distance from the waterfront of Farmers Island to permit the building of piers along this front. It will probably be found profitable to rearrange the other railroad lines in order to provide more direct handling of materials from railroads to vessels. Subsequent developments, of course, will prove whether the use of carfloats or direct railroad connection would be the most profitable arrangement.

Protection Against Inundation

The next recommendation of the report advises definite action in providing against inundation by the sea. This would mean the elevation of railroad tracks, piers or other cartage facilities above the Gulf flood level. Such a move would provide permanency of construction which would serve greatly to decrease the liability of insurance companies at these ports, and, consequently, would decrease the insurance rates, a factor which should be carefully considered in relation to economical terminal operation.

Specifically, Mr. Donnelly suggests as preliminary construction work the building of a secure bulkhead on a site now occupied by the Commercial wharf. This construction which should be 1,240 feet long by 118 feet wide would probably cost about $200,000 (£41,000).

As an economical provision for storage facilities it is proposed that a four story concrete fireproof warehouse be built on the new bulkhead at an approximate cost of $1,250,000 (£256,000). By this arrangement three stories would be available for permanent storage, and the pier floor, subject to inundation, could be occupied by temporary cargoes. Mr. Donnelly suggests, however, that future warehouse developments be undertaken by private capital. At a later date he recommends the building of other concrete fireproof piers approximately 800 feet long by 200 feet wide to be covered with fireproof concrete sheds. These piers which would be located between 300-foot slips would cost approximately $1,250,000 (£256,000) each. Mr. Donnelly has suggested that $5,000,000 (£1,025,000) expended over a five year period would be a sufficient fund to carry the construction to a profitable conclusion.

Future Industrial Development

In taking up the possibilities for the future industrial development at Mobile, he emphasizes that this port could well be used as a manufacturing point for imported raw material, such as cabinet woods from California or South America. Mobile would then become a redistributing point for this kind of goods. He also shows that the bark now split from the lumber, which is exported, might be profitably used for the tanning of hides which could be brought in to Mobile from the west.

Such industrial development would mean extensions in all directions. Probably these would first be located inland from the harbor proper. The southern development of the harbor of Mobile toward the bay should not be overlooked, however, but the extension of Blakeley Island to the east and Sand Island to the west of the main ship channel would be considered as reserved for individual development such as the handling of coal and ores, which would require considerable area and specially constructed terminals. The development of this portion of Mobile harbor will require very rugged construction to meet the conditions in the much more exposed location, and its added distance from rail connection will increase the cost of operation. It will therefore be most suitable for the transfer of commodities between river and ocean carriers, either for export or import.



Fig. 1.—Critical Moment at the Launching of a Ship at the Shooter's Island Yard

Swiftest Submarine in the World

The fastest combination submarine in the world has been built at the Fore River plant of the Bethlehem Shipbuilding Corporation at Quincy, Mass. The *AA*-1 built for the Electric Boat Company returned from her recent trial trip with a record for performance that excells any submarine yet built.

The *AA*-1 is 270 feet long, 20 feet beam, 14½ feet draft. On the surface she made 20.75 knots, exceeding her contract by .75 knot. Submerged she made 12.5 knots which is one knot more than required.

The *AA*-2 and the *AA*-3 will soon have their trial trips.

Shop Competition at the Shooter's Island Yard of the Standard Shipbuilding Corporation

CONFIDENCE in the future prospects of shipbuilding has led the officers of the Standard Shipbuilding Corporation at Shooter's Island, N. Y., to plan for a steady programme of building in the future. Improvements have consequently been made in the shops at the yard. The plate shop, boiler shop, blacksmith shop, pipe shop and machine shop have been enlarged, while new construction includes an office building containing private rooms, a dispensary, a rigger's loft, tool storage, outside machine shop and a paint shop.

The various shops in the yard have carried on a keen competition in construction and equipment. Complete equipment for the ships building at the yard is now provided by the boiler shop, machine shop, blacksmith and pipe fitting shops.

The boiler shop has reached the point where it is able to produce one complete single-ended three furnace Scotch boiler (14 feet inside diameter) fitted with a heated draft system, per week. All boilers are built for 190 pounds pressure.

In three and one-half weeks the machine shop has completed the engines and auxiliaries for one ship. This equipment includes one 3-crank triple expansion engine with cylinders 25 inches, 41 inches and 70 inches diameter by 48 inches stroke, developing 2,500 indicated horsepower; a main surface condenser having 3,500 square feet of cooling surface; one auxiliary condenser with 500 square feet of surface; one 14-inch centrifugal circulating pump and its power unit; a single cylinder 10-inch by 10-inch engine; one direct connected air pump; two 5-inch by 20-inch direct connected bilge pumps. In addition independent pumps have been built as follows:

One 4½-inch by 3¾-inch by 4-inch feed water pump.

One 10-inch by 14-inch by 16-inch ballast pump.

One 12-inch by 8½-inch by 12-inch fire bilge and general service pump.

One donkey engine feed pump, one evaporator, one feed water heater and one forced draft fan.



Fig. 2.—Blacskmith Shop at Shooter's Island Yard

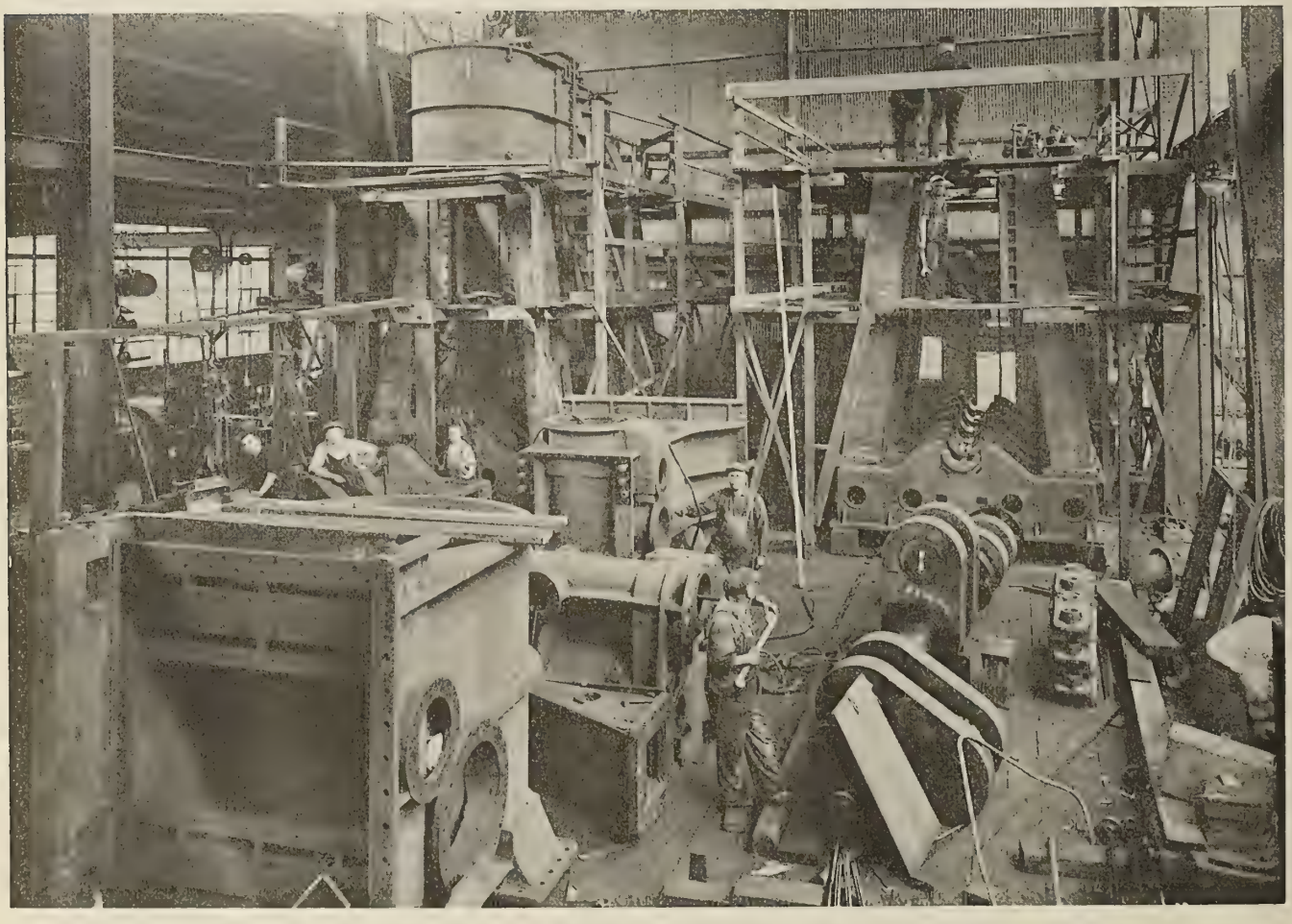


Fig. 3.—Assembling Floor in the Shooter's Island Machine Shop



Fig. 4.—Main Bay in Shooter's Island Machine Shop



Fig. 5.—Where Propeller Shafting is Manufactured for the Standard Ships Built on Shooter's Island

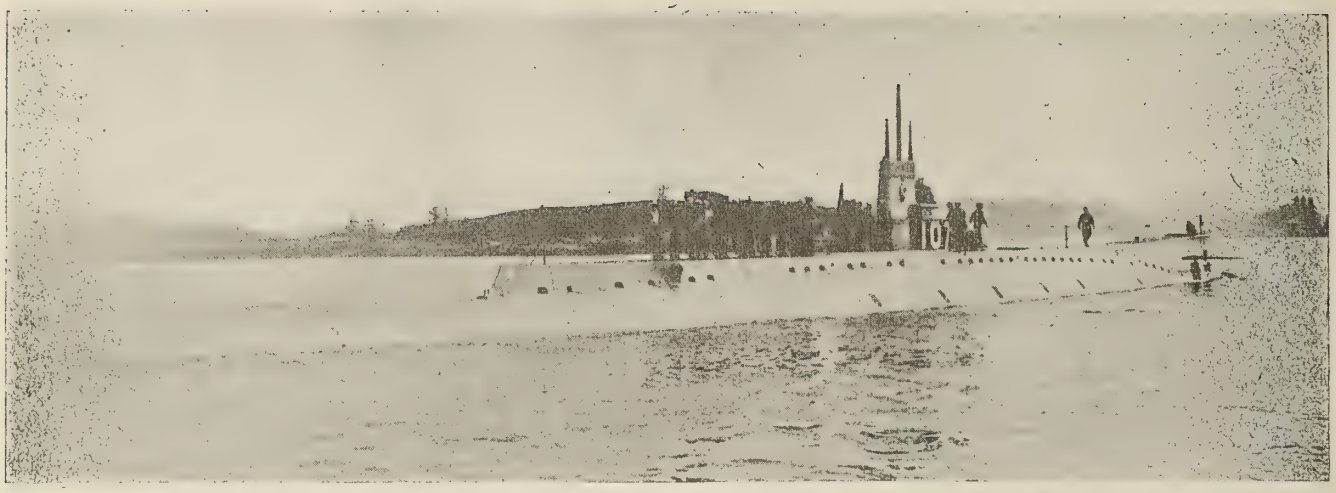


Fig. 1.—U. S. Submarine, 800 Tons Displacement; Speed, 15 Knots on Surface, 12 Knots Submerged

Electrical Equipment on Submarines

Propelling Machinery Consists of Two Separate Motors Combined in One Unit — Method of Control — Auxiliary Motors

FEW pieces of electrical apparatus are more difficult to design than the motors of submarines. These motors must not only propel the boat when it is submerged, but must also start the engines and act as generators for charging the batteries during surface cruising. They must be of the utmost reliability, as they are in almost constant use; they must be highly efficient at all speeds so as to permit as large a cruising radius as possible from a battery charge; and they must be practically noiseless for military reasons. Their weight and the space they occupy must be at a minimum for their horsepower capacity, and their dimensions must conform to the confined space into which they are crowded. The internal parts must be thoroughly protected from oil and water, but at the same time they must be well ventilated, to prevent overheating, and be as accessible as circumstances permit.

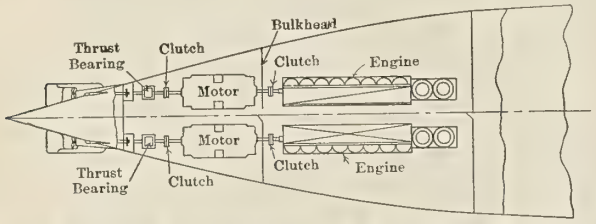


Fig. 2.—General Arrangement of Propelling Machinery

The motors built by the Westinghouse Electric & Manufacturing Company for the latest type of United States submarine, shown in Fig. 1, illustrate how these conditions have been met.

Construction of Motors

As shown by Fig. 2 there are two motors to each submarine. Each motor is coupled to a Diesel engine at its forward end and to a propeller at its aft end. When the motors are driving the boat the engines are uncoupled, and when the engines are used they drive the propellers through the motors, the armatures of the latter either turning idly or generating current to charge the batteries. The motors are similar in design, and each is rated at 600 horsepower for continuous operation at 260 revolutions per minute and 220 volts.

The special feature of this type of motor is that it really consists of two motors, forming a single compact unit. As shown by Fig. 5, there are two armatures, mounted on a common shaft and as shown by Fig. 6, there are two separate field windings carried by the frame. This arrangement results in a long and narrow outline, which is well adapted to the space available for installation, and it also provides certain advantages in control, which will be explained later.



Fig. 3.—Inboard Side of Propulsion Motor

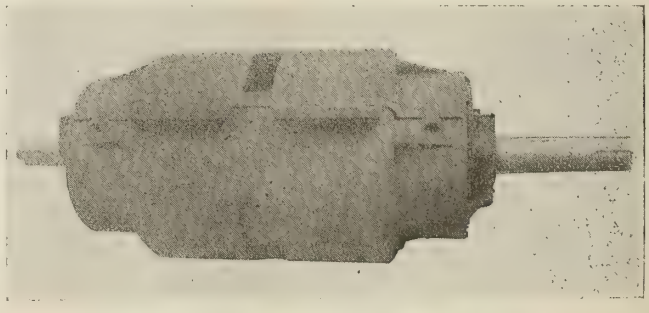


Fig. 4.—Outboard Side of Propulsion Motor

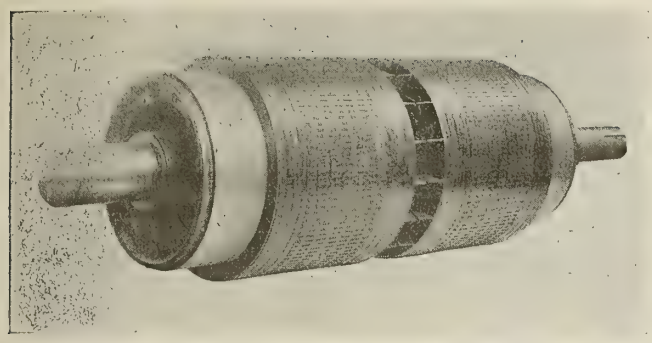


Fig. 5.—Double Armature of Propulsion Motor

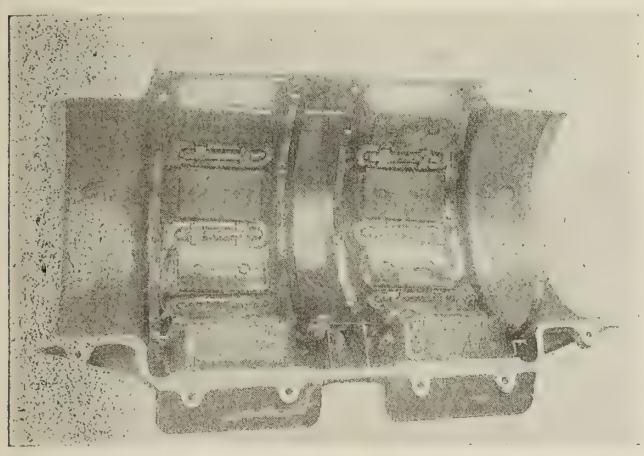


Fig. 6.—Motor Frame, Showing Two Sets of Field Coils

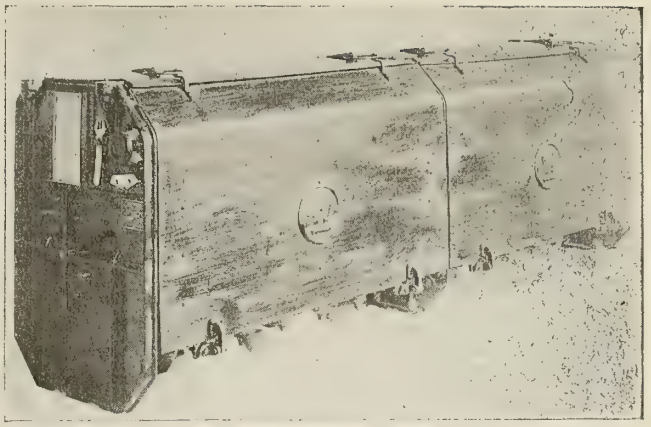


Fig. 7.—Exterior of Switch Group

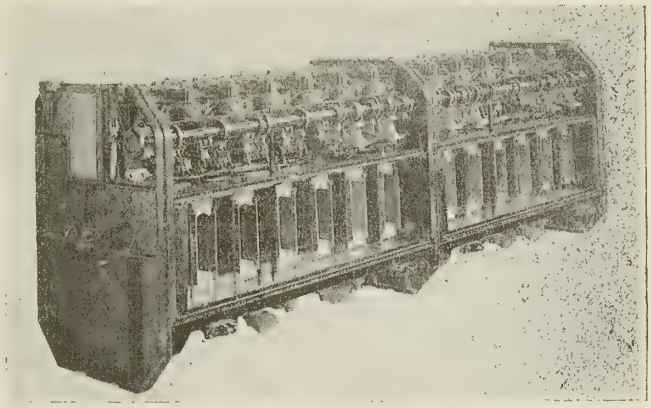


Fig. 8.—Switch Group with Cover Removed

The frame entirely encloses the motor and is split at an angle of 30 degrees from the horizontal so the upper part can be removed in the low head room. The feet are also arranged at the same angle so as to fit the hull of the vessel. Forced ventilation is furnished by a motor-driven blower (not shown in the illustrations) which is mounted directly above the motor. The air enters the slot in the frame shown in Fig. 4, is directed in its proper path by a sheet steel duct shown in Fig. 6 and emerges through the slot shown in Fig. 3.

The bearings are carried in the solid end brackets and are of the sleeve type lubricated by oil and waste similar to railroad practice. Arrangements are made to prevent oil from leaking into the windings.

The main field consists of a shunt winding with a light series winding to produce a drooping speed characteristic, which provides for a satisfactory division of the load between the two armatures when operating in parallel. Commutating poles are placed between the main poles to suppress sparking at the commutator. The main poles are slightly skewed, as shown in Fig. 6, to reduce the noise of operation.

Hand holes are provided in the frame which give access to the brushes and commutators, and the brushes are mounted on a rigging which can be revolved so that all of the brushes can be inspected through the holes.

Control

The clutches connecting the shaft with the engine and with the propeller are so designed that the motor thrust-bearing has to carry only the thrust due to the weight of the armature and the clutches when the boat dives at an angle. The propeller thrust is carried by a special thrust block.

Because of the variety of combinations that can be obtained by connecting the two armatures of each motor unit in series or parallel and by dividing the 120-cell storage battery into two parts, connected in a similar manner, a wide range of economical speeds can be obtained without installing extra units.

For high speeds the two sections of the battery are connected in series and the motor armatures in parallel, thus impressing full voltage on each armature. For medium speeds the battery sections and the armatures are both connected either in series or in parallel, giving the armatures half voltage in both cases. For low speeds the battery sections are in parallel and the armatures in series, so that each armature receives one-quarter voltage. With each of these connections a range of intermediate speeds is available through the use of field resistance.

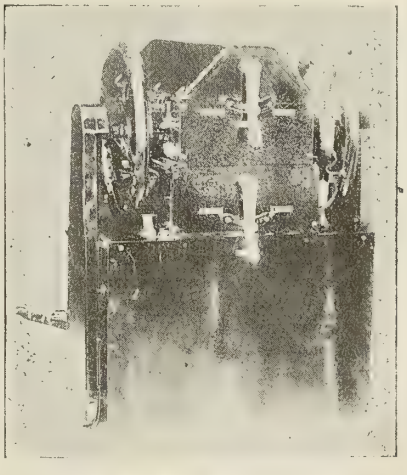


Fig. 9.—Master Controller

Interlocked electrically operated switches are used for controlling most submarines, but some of the latest types are controlled by an electro-pneumatic system.

This system comprises two main parts: a switch group for each motor unit, shown in Figs. 7 and 8, which makes the actual connections, and the master controller, Fig. 9, which controls the operation of the switches for all of the motors, either when propelling the vessel or when charging the batteries.

The switch group which is mounted in the motor room of the submarine consists of fourteen switches, which make the connections for cutting out the resistance in starting the motors and for reversing. Each switch is operated by compressed air, but the air valve of the switch is controlled electrically by the master controller, so that by opening or closing a contact on the master controller the corresponding switch in the switch group is opened or closed. This system is a modification of that used in controlling electric locomotives.

The master controller is located in the central operating compartment of the vessel. The motor units are controlled by the hand-wheels mounted on the sides of the controller. When one of these wheels is turned to the starting position (indicated by a dial and a pointer), a control drum within the controller is turned so as to close the contacts which operate the proper switches of the switch groups to start the corresponding motor. These switches close in the proper order, cutting out the starting resistance and bringing the motor up to speed. Further manipulation of the hand wheel changes the speed of the motor, reverses it, or stops it. Another set of drums within the controller arranges the connections so that the two armatures of each motor can be connected in either series or parallel; these drums are interlocked with the hand-wheels so that they can be moved only when the hand-wheels are in the off position.

Two handles are shown mounted on the front of the controller. These arrange the connections so that either of the armatures of each motor unit can be cut out in case of accident and the propeller operated by the other one.

Provision is made for operating the switches manually in case the electric master control circuit is interrupted.

Auxiliary Motors

In addition to the propelling motors, the following auxiliary motors are required for the class of submarine being described:

AUXILIARY MOTOR EQUIPMENT OF A TYPICAL MODERN UNITED STATES SUBMARINE

Number per Boat	Application	Horsepower Each
2	Air compressor and ballast pump	45
2	Engine circulating water pump	10
1	Anchor windlass	10
1	Steering gear	7.5
1	Oscillator generator	7.5
1	Adjusting pump	7.5
2	Main motor ventilating fan	5
1	Stern diving rudder	4
1	Bow diving rudder	3
3	Periscope hoist	3
1	Wireless generator	3
1	Engine lathe	3
1	Radio mast hoist	1.5
1	Bilge pump	1
2	Lubricating oil pump	1
1	Fuel oil pump	1
1	Sounding machine	½
1	Drill press	¼
1	Grinder	¼
1	Refrigerating machine	¼
7	Hull and battery ventilating fan	¼
3	Hull ventilating fan	⅛

Some of these motors must be watertight, others semi-enclosed, and others can be open, depending upon their application. The constant-speed motors, such as those driving the pumps, are started by means of automatic starters with push button control. For the adjustable-speed motors, such as those driving the fans, manually operated speed controllers are generally used.

The control of the diving and steering mechanism is so arranged that if the electric circuits fail manually operated controls are automatically thrown into gear. The rudders and diving planes are equipped with limit switches, which stop the motors operating them when the limit of travel is reached.

Electricity is also used on submarines for signalling, telephoning, discharging torpedoes, driving the gyro-compass, operating the radio outfit and the submarine listening devices, and for lighting, heating and cooking.

Skinner & Eddy Building Four 10,400-Ton Freight Vessels

THE Skinner & Eddy Corporation, Seattle, Wash., is now building four 10,400-ton deadweight cargo vessels according to plans developed by the company's engineers, James Barclay, C. N. McCallum and Melville H. Kiel. The ships are being constructed under the supervision of Lloyd's and the American Bureau of Shipping. The new vessels will be 439 feet 9½ inches overall, 425 feet between perpendiculars, have a beam of 55 feet and a molded depth to the shelter deck of 36 feet. Loaded they will draw 26 feet 9 inches of water; at peak load the draft will be 27 feet 4 inches.

Three Scotch boilers, 14 feet 9 inches in diameter and 11 feet 9 inches long, will be installed. These boilers, each with a heating surface of 3,000 square feet, are built for 210 pounds working pressure. The General Electric Company's geared turbine engines of 3,000 shaft horsepower will be installed. The vessels are designed to maintain a speed of 12 knots.

Four 5-ton booms will be provided at each mast, two to each hatch, with a 3-ton boom at the mizzen hatch. An additional 30-ton boom, with winches operated by compound gearing, will serve hatch number two for heavy lifts.

These vessels are of the shelter deck type, with three steel decks, five cargo holds and a deep water ballast tank aft of the machinery space which may be used for stowing cargo. Fuel oil, carried in the double bottom, is sufficient to provide a steaming radius of about 10,000 miles. The fore and aft peak tanks provide additional fuel storage to bring the steaming radius up to 13,000 miles. Copper will be used for salt water pipes, feed pipes and exhausts. Steam pipes will be composed of steel with forged steel flanges. It is estimated that the first of these vessels will be ready for launching about January 1, 1920.

The American Steamship Association has unanimously endorsed the resolutions adopted by the National Merchant Marine Association which provide for the sale of steamers of less than 6,000 tons to American or foreign interests; the sale of the larger ships to American citizens within two years on a deferred payment plan; the exemption of earnings of vessels purchased from the Shipping Board by American interests from excess profits taxes, and the assistance of the Government in the construction and operation of new passenger tonnage.

An American Load Line

BY CAPTAIN C. A. MC ALLISTER, U. S. C. G. (Retired)

The necessity for immediate load line regulation in this country, as provided in Senate Bill 575, is emphasized in the following article and in this connection an account of the development of similar legislation in Great Britain serves as an instructive background for a study of the situation here.

STRANGE as it may appear, there is no official load line for American merchant vessels. That the United States alone, among all the leading maritime nations of the world, has not officially recognized the vital importance of this means for the protection of the life and property of its citizens on the seas may only be ascribed to the general apathy into which this country has drifted for the past forty years concerning all maritime matters. Fortunately for all concerned, the great impetus given to our merchant marine, as an incident of the world war, has now brought this and kindred subjects acutely to the forefront. From surface indications, at least, relief is in sight.

> In an average-sized vessel . . . a difference of even one inch in the location of the load line means a difference of approximately 50 tons of cargo which may be carried. Five or six inches of difference when capitalized into freight revenue might be a sufficient differential to exclude an American vessel from the keen competition which always exists in the ocean carrying trade in normal times. . . . It is probable that international comity has prevented unjust discriminations against American vessels in foreign ports on this account, but there are well-defined rumors to the contrary. . . . Such a condition is most untenable from an American standpoint.

Origin of Plimsoll Marks

It is well to approach this subject from an historical standpoint. There seems to be, even among shipping men, an idea that some countries—notably Great Britain, because of her predominating influence in maritime affairs—have had a recognized load line for nearly a century. This is not so. The first governmental restriction on the loading of ships was not enacted until 1875.

It appears that the subject had been bruited for a long time, and complaints made that unnecessary loss of life at sea had occurred, due to the greediness of shipowners for increased revenues manifested in the overloading of their vessels. This sentiment for the safety of seafarers was finally crystallized into legislation by Parliament, fathered by the late Samuel Plimsoll, and embodied in the Merchant Shipping Act of 1875. His legislative efforts have immortalized him among seamen, as the disks and lines painted on the sides of ships to indicate the safe depth to which seagoing vessels may be loaded are now almost universally known as "Plimsoll Marks."

This initial governmental regulation was grossly inadequate to the demands, inasmuch as it was to remain in force for one year only and was applicable only to foreign bound vessels. Presumably this provision was for experimental purposes and the restrictive features were incorporated incidentally to appease the inevitable opposition to new regulatory provisions of law which are construed by the unthinking and unpatriotic as invasions of private rights. However, the merits and justice of the regulation must have appealed to the majority of people interested, for in 1876 an amendatory act was passed making the affixing of load line marks on all British vessels obligatory on the part of the owners, except certain small craft under 80 tons register engaged in the coasting or similar trades. Even this extension of authority failed lamentably, since no regulations were passed indicating where the load line should be fixed, and the carrying out of this regulation was still optional with the owners. After the load line was affixed, however, it was declared to be illegal for the vessel to be loaded beyond that limit. To show the laxness of such a law, it is related that one facetious shipowner actually placed the Plimsoll Mark on the smokestack of his vessel.

Compilation of Freeboard Tables

There were no further legislative enactments in Great Britain until the year 1890. In the meantime, however, the shortcomings of the then existing laws had become so apparent, especially in view of the power given to the Board of Trade in 1873 to prevent the sailing of ships overloaded, that it was found necessary for that body to work out in a scientific manner certain tables of freeboard, in order that it might exercise judicially the power thus vested by Parliament. These tables were not published until 1882—in the same year British Lloyds issued tables on the same subject. These tables were adopted in 1883 by the Board of Trade. To the credit of many shipowners these tables were voluntarily adopted, and either of the above institutions affixed the load lines in accordance with the tables compiled. This arrangement worked out so satisfactorily that in 1890 an act was passed making it obligatory that the load lines be affixed in accordance with the Board of Trade rules in use at the time of the passage of this act. Under the provisions of the same legislation the Board of Trade was authorized to appoint British Lloyds and any other approved agency to certify for the Board the position of the load line. Under this authority the Board appointed British Lloyds, the British Corporation and the Bureau Veritas as its agents for the purpose intended. Other leading maritime nations have, in substance, adopted the same procedure.

Revision of Load Line Tables

The Board of Trade under the act of 1890 was empowered to accept certain modifications in the then existing rules, upon representations made to its agencies for the affixing of load lines by authorized agencies where ships of exceptional construction were involved, with the inhibition that such changes must be made with great skill, care and judgment. With the disappearance of old types of vessels, the substitution of new types and conditions, and the general advance in the art of naval architecture, this permissive statute was judiciously invoked, and in 1906 all such modifications were embodied in the revised rules of the Board of Trade, which have continued in force up to this time. The general effect of the revised table was to permit certain types of vessels where

greater precautions for seaworthiness had been taken to carry greater loads than would have been possible under the previous tables. A committee to investigate the effect of this revision of the Board of Trade rules and to consider a further revision has made a most comprehensive report on the whole subject of load lines, taking into account the casualties and loss of life both before and after the 1906 revision. In general, it may be said that this revision was wholly beneficial, as indicated by slight decreases in both casualties and losses of life, as well as an increase in cargo carrying capacities in certain vessels. Most of the facts contained in the foregoing historical references are taken from this report.

It is needless to rehearse for the technical reader the advantages to be gained by load line legislation in this country, but for those not cognizant of the effect of such governmental regulations it may be pointed out that, aside from the universally admitted protection to life and property, which the safe loading of carriers by sea helps to insure, there are other reasons for such enactments. The success of the operation of vessels at sea depends most largely upon the revenue received from the amount of freight carried. The affixing of a load line mark is a restriction upon the depth to which the vessel may be loaded, and consequently upon the weight of the cargo carried.

In an average-sized vessel, such as has been or is now being built by our Shipping Board, a difference of even one inch in the location of the load line means a difference of approximately 50 tons of cargo which may be carried. Five or six inches of difference, when capitalized into freight revenue, might be a sufficient differential to exclude an American vessel from the keen competition which always exists in the ocean carrying trade in normal times. Under existing conditions such a state of affairs is entirely possible, and, it may be added, probable.

While the load lines now unofficially fixed on many American ships operated by the Shipping Board are recognized by our port authorities in allowing vessels to sail to foreign ports, there is nothing in the law or practice which requires any foreign port officials to recognize the load lines on these American vessels when sailing from such ports to our own shores. Also, there are no statutes which would prevent foreign vessels from sailing from our ports, even if laden beyond their load lines. It is probable that international comity has prevented unjust discriminations against American vessels in foreign ports on this account, but there are well-defined rumors in shipping circles to the contrary. Such a condition, it may be admitted by all concerned, is most untenable from an American viewpoint. Some American vessels have had lines affixed through the agencies of foreign classification societies in this country, and these vessels, since they are recognized by the British Board of Trade, have no difficulties, and probably will have none.

To Americans interested in shipbuilding, ship insuring and operating, this lack of legislation has been a matter of serious concern for many years. Although spasmodic attempts have been made to remedy conditions in this respect, nothing tangible has been produced. True, in 1916 a conference of all concerned was called by the Secretary of Commerce and a committee of prominent technical men was appointed to draft the necessary bill, but in the general confusion in maritime matters which resulted upon our entrance into the World War no action has yet been taken. Fortunately, however, there are now pending similar bills introduced by Senator Fletcher in the Senate and Representative Alexander in the House, which, if enacted, will be a long step in the right direction.

All maritime nations have practically agreed upon the load line rules as proposed and revised by the British Board of Trade from time to time. This agreement, however, has no legal status, and to obviate this the International Conference on Safety of Life at Sea held at London in 1913 unanimously agreed on behalf of the nations there represented that as soon as convenient there would be a further international conference to discuss and adopt a standard of load line fixing throughout the maritime world. War conditions have up to this time effectually prevented such a gathering, but it is highly probable that at no very distant date such a conference will be called. For the United States to enter such a conference with no legally adopted system of load line fixing would indeed be a serious handicap, and this condition adds another to the many reasons for immediate action on this important subject. So far as is known, all parties concerned, including the executive branches of the Government having cognizance, have agreed upon the terms of the pending bill.

There is ample technical talent in this country for formulating and discussing the many intricacies entering into scientifically prepared rules for load line fixing, and it is in the interest of the shipping fraternity of this country that Congress signifies its early approval of legislation, in order that designers and ship operators may have time to prepare an American presentation of views concerning this vital concomitant of a successful merchant marine.

The New Load Line Bill

The salient features of Senate Bill No. 575 are as follows:

(a) Makes load line regulation applicable to cargo-carrying vessels of 500 gross tons and upwards loading at any port in the United States for a foreign voyage.

(b) Makes load line regulations applicable to any American cargo vessel loading at any foreign port for any voyage.

(c) Makes load line regulations applicable to any other American vessel loading at any port, where, in the judgment of the Secretary of Commerce, the safety of ship and crew requires the establishment of a legal load line.

(d) Provides that the Secretary of Commerce appoint the American Bureau of Shipping, or any other corporation or association selected by him, as agents in the affixing of load lines.

(e) Provides that reciprocal relations be established with foreign countries regarding mutual recognition of load line fixing.

(f) Authorizes the collectors of customs to withhold clearance papers from any American or foreign vessel, when loaded in violation of the load line acts at home or abroad. Provides penalties for violators.

(g) Provides penalties for illegally changing or obliterating load line marks fixed in accordance with law.

(h) Makes the act effective within six months of the date of its passage.

Latest British Destroyer

The *Witherington*, a new and powerful destroyer was delivered to the British Admiralty on October 10. This vessel was built by J. Samuel White & Company, Ltd., East Cowes, Isle of Wight. The ship, which has a displacement of 1,450 tons, attained on her trials a speed of 35 knots. Her propelling machinery consists of two Brown-Curtis geared turbines and oil-fired White-Forster watertube boilers. The same type of boilers is installed on the world's fastest vessel, the United States destroyer *Cole*, which has a speed of 41.1 knots. The *Witherington* is the seveny-first torpedo vessel completed at the White shipyards.

Design Departments of Bethlehem Shipbuilding Corporation Centralized at Bethlehem

Drafting Departments of Five Companies Consolidated—Hull and Machinery Divisions Subdivided to Expedite the Work

WHEN the Bethlehem Shipbuilding Corporation, Ltd., was formed in October, 1917, by a consolidation of the shipyards that now make up the five plants of the company, the central office was established at Bethlehem, Pa. Here are located the executive, financial, purchasing, and engineering departments of the corporation. The principal plans for the hulls and the machinery of the vessels constructed at the various yards are prepared at Bethlehem, thus making the standardization of detail parts possible, with the resultant economy in construction cost. Designs for improvements and extensions to the different plants are also prepared at the central office.

Organization of the Technical Department

The amount of work handled in the engineering departments at Bethlehem necessitates the employment of an exceptionally large corps of draftsmen and designers. This force has been built up around the technical organizations transferred from the consolidated companies. The consolidation of these five plants, representing a variety of work constructed by both east and west coast methods, requires at the central office an organization which is capable of handling every kind of marine work, ranging, in the mechanical field, from the smallest auxiliary to the largest turbine, and, in the architectural field, from the small tug boat to the largest type of naval craft.

The technical department, in charge of a technical manager, is subdivided into the hull division, under a naval architect, and the machinery division, under a chief engineer. Under the naval architect an assistant naval architect handles the Government work, another assistant the merchant work, and a third assistant is in charge of new designs and specifications. Each man is the active, responsible head of his division. The machinery division is similarly organized; four assistant engineers under the chief engineer are responsible for the machinery for Government installation, merchant machinery, auxiliaries and electrical work. In general, each assistant naval architect or assistant engineer has his chief draftsman directly in charge of the work in the drafting room.

For handling the actual work in the drafting room, the squad system is used, each squad of draftsmen being in charge of a supervisor who is capable of taking care of the designs of hull or machinery for an entire vessel or a definite part of a vessel. As far as possible the men are given an opportunity to work upon designs in which they are especially experienced.

Process Tracings Distributed to the Yards

Designs for vessels are distributed to the shipyards on "process tracings" made from the original tracings, which are retained at the central office. This method of distribution obviates the necessity of sending out a large number of blue prints and also makes it possible to make



Fig. 1.—Looking Down the Long Drafting Room of the Technical Department, Bethlehem Shipbuilding Corporation, Ltd.



Fig. 2.—The Ship Engineering Building in Which the Drafting Room of the Bethlehem Shipbuilding Corporation is Located

minor changes on the process tracings at the yards. The same changes are made on the originals at the central office for record. The process tracings, made by a special process on tracing cloth, can be erased and changed as readily as an ordinary tracing made in India ink. The company maintains its own process tracing department at Bethlehem and has found the use of these tracings very satisfactory.

Plan of the Drafting Room

Except for the marine auxiliaries and electrical work, the drafting of the technical department is all done in one immense drafting room which occupies nearly the entire third floor of the ship engineering building illustrated. The arrangement of the offices of the technical department is shown in the plan view. The drafting room, which extends the full length of the building, 350 feet, accommodates 400 draftsmen comfortably. The room receives light from windows on all sides; consequently the light is well distributed over the whole room and artificial lighting is seldom necessary.

Plans for improvements and extensions at the yards are prepared at Bethlehem in the plant engineering department, which is in charge of the mechanical engineer, reporting to the manager's department. This department which makes up the principal designs for mechanical, structural, architectural and electrical work in connection with new plant extensions, is separate from the technical department, having its own drafting room and offices.

The building in which the engineering departments are housed is located in the residential section of Bethlehem, across the street from the campus of Lehigh University. The situation provides plenty of fresh air with quiet and pleasant surroundings, although conveniently located to all railroad stations and within a block of the street car lines. Practically all employees residing in Bethlehem can walk to and from work.

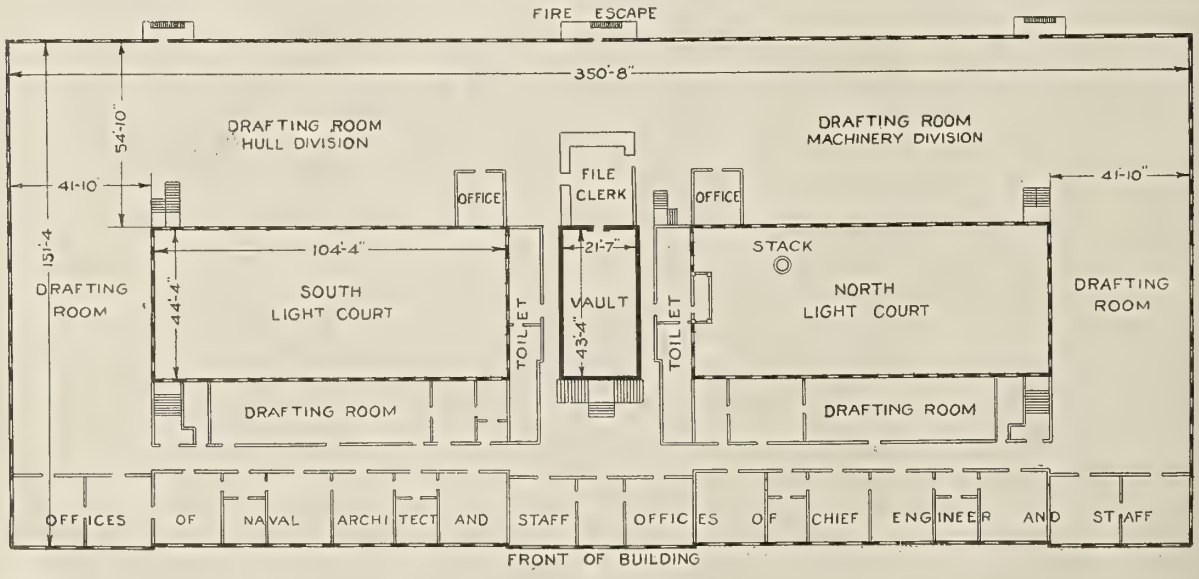


Fig. 3.—Arrangement of Drafting Room, Technical Department, Bethlehem Shipbuilding Corporation, Ltd.

In order to encourage employees to fit themselves for better positions with the corporation, opportunity is given by the company for young men at the yards, who would be fitted for the work by inclination or by some previous knowledge of drawing, to come to the central office and work as designers or draftsmen. The wide variety of the work handled at the central office affords unusual diversity for the employee, and the company finds that a centralized system produces excellent results.

Our Former Enemy Ports

Kiel, Cuxhaven, Heligoland, as well as Hamburg up from the coast, all received their share of "place" in the German scheme of things when the Imperial Government calculated measures to spread her rule over the earth. These are ports and bases from which Germany intended to strike from off the high seas all allied shipping and fleets. Germany failed, and as places of stealthy hiding and lurking, Kiel and Heligoland are done.



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Heligoland



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Harbor of Kiel with the German Fleet Bottled In

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Delamater-Ericsson Memorial

THE American Society of Mechanical Engineers will hold a memorial meeting on December 3 at 8 P.M. in the Engineering Societies building, 29 West 39th street, New York, to commemorate the Phoenix Foundry, which was operated on West street between Vestry and Laight streets, New York, from 1838 to 1851, and the Delamater Iron Works, operated at the foot of West 13th street, from 1851 to 1889. Tablets will be erected on these sites. It was in these plants under Cornelius H. Delamater and Captain John Ericsson that great advances were made in naval architecture and marine engineering during this period. Anyone who has in his possession prints or documents relating to these works is requested to communicate with H. F. J. Porter, chairman, Delamater-Ericsson Memorial, American Society of Mechanical Engineers, 29 West 39th street, New York.

Competitive Tests of Electric and Geared Turbine Drive

WITH the building of five sixteen-hundred-ton, sixteen-knot coast guard cutters, two of which are to be fitted with electric drive and three with geared turbines, an opportunity will be given to secure exact data as to the relative merits of geared turbine and electric propulsion. Keels for these vessels have been laid at the Everett, Wash., plant of the Norway Pacific Construction and Dry Dock Company, and it is expected that the vessels will be completed within ten months. The hulls of the five vessels will be exactly alike. Oil-fired watertube boilers will be installed and the propelling machinery will develop 2,600 shaft horsepower giving the vessels a speed of sixteen knots with a cruising radius of 7000 miles.

Many years ago when the compound reciprocating marine engine was first proposed for ship propulsion the United States Coast Guard Service (at that time known as the Revenue Cutter Service) carried out similar comparative tests of the new and old type of propelling machinery in sister ships. The reports of these tests have been one of the most valuable classics in the field of marine engineering, both because of the ideal conditions under which the tests were made and because of the scientific manner in which the results were obtained. That the forthcoming tests of electric and geared turbine machinery will have the same, if not greater scientific value, goes without saying. These tests, however, will be of special value to shipowners because of the fact that the size of the propelling units to be installed in these vessels is practically the same as that of the average cargo steamship so that the results will have a direct application to merchant ships.

Recognition of the American Bureau of Shipping

SOME time ago a special committee representing shipowning, shipbuilding and allied interests was appointed by the Shipping Board to investigate the classification and rating of vessels. In the report of this committee, recently submitted to Congress, a number of highly important recommendations were made. First of all, the committee recommended that all technical questions concerning the construction of merchant vessels built or operated under the laws of the United States (in so far as such matters are regulated by statutes) should be submitted to the American Bureau of Shipping as the principal advisor to the executive branch of the Government under which supervision of such matters may rest. Incidentally, it is recommended that the American Bureau of Shipping be the regularly constituted authority for fixing load lines and freeboard, as provided in the Alexander bill now before Congress. Further than this, it is recommended that a joint committee with representatives from the proper Government authorities and the American Bureau of Shipping be established as the principal advisory authority to deal with all matters relating to the safe construction of ships and their machinery.

As compared with other maritime nations, the United States has been at a disadvantage on account of its lack of recognized authorities to pass officially upon such technical matters as outlined in the recommendations of this committee. Many difficulties and delays would be obviated if the authority of such committees as are designated in this report were recognized by the Government.

American Shipbuilder Surveys British Shipyards

HOLDEN A. EVANS, president of the Baltimore Dry Docks and Shipbuilding Company, Baltimore, Md., has just returned from Europe where he made a very complete industrial survey of the British shipyards. In his opinion the structural work on American vessels, barring possibly some vessels constructed under particular stress during the war period, is superior to the work in British yards. His visit to the Clyde shipyards revealed that these plants are uneconomically constructed for cheap shipbuilding and that England's present superiority as to cost of ship tonnage is due principally to the advantage of cheap labor which she enjoys although at present labor is growing much higher in England. Foreign shipping

firms, he said, are still distrustful of American ships because of unfortunate propaganda now circulating in business circles. The Englishman, because his shipbuilding methods are different, has had a fundamental distrust of the American-built ship, and the loose propaganda in American newspapers regarding certain American firms has been applied to American shipbuilding at large.

As a result of his investigations Mr. Evans has declared that our shipyards are ahead of the English yards in compactness, efficiency and speed, due in many cases to modern equipment for handling materials and better planned yards. A detailed report of his findings will be submitted to the Shipping Board.

Programme of the Naval Architects Meeting

FOLLOWING is a list of the papers at the twenty-seventh general meeting of the Society of Naval Architects and Marine Engineers in New York on November 13 and 14:

THURSDAY, NOVEMBER 13

"Methods Employed in the Construction of Concrete Ships." By R. J. Wig.

"Engineering Features of Shipyards Operative During the War Period." By Captain R. E. Bakenhus, U. S. N.

"Steel Ship Construction from a Management Viewpoint." By Creighton Churchill.

"An Analysis of the Isherwood System of Ship Construction." By John Flodin.

"Economical Cargo Ships." By A. J. C. Robertson.

"Non-Rolling Passenger Liners." By E. A. Sperry.

"Submarines in General—German Submarines in Particular." By Commander E. S. Land, U. S. N.

FRIDAY, NOVEMBER 14

"Propulsive Efficiency of Single Screw Cargo Ships." By Commander William McEntee, U. S. N.

"Buoyancy and Stability of Troop Transports." By Professor William Hovgaard.

"The Application of Standardization and Graphical Methods to the Design of Cylindrical Boilers." By H. C. E. Meyer.

"New Developments in High Vacuum Apparatus." By G. L. Kothny.

"The Launching of Large Vessels in Restricted Waters." By Captain H. M. Gleason, U. S. N., and Lieutenant Commander H. E. Saunders, U. S. N.

"The Propelling Machinery of the U. S. S. *Leviathan.*" By E. H. B. Anderson.

"Standard Oiling System for Geared Turbines." By J. E. Schmeltzer and B. G. Fernald.

"Electric Propulsion on Merchant Ships." By W. L. R. Emmet.

The meeting will be held in the Engineering Societies building, 29 West 39th street, beginning at 10 A. M. each day of the meeting. The Council of the Society will meet in the Council Room on Wednesday afternoon, November 12, and the annual banquet will be held in the Grand Ball Room of the Waldorf-Astoria Hotel on Saturday evening, November 15 at seven o'clock.

American Fuel Stations

DURING the early stages of the war, Great Britain put into effect a system of bunker license as a necessary military measure. The United States Shipping Board realized that after-war conditions might develop a situation with respect to coal supplies which would dictate the necessity of a modified application of bunker license at British stations. In that event American shipowners would have been at a serious disadvantage unless immediate steps were taken to assure unrestricted operation of their ships in the world's trade. To accomplish this it was necessary to have oil burning steamships, instead of coal burners, and vessels with a steaming radius of at least 10,000 miles when practicable. The British order of September 29, 1919, justified these apprehensions.

It therefore became necessary for the Shipping Board to find suitable places for the establishment of fuel stations along the trade lanes or adjacent to them. At the Panama Canal facilities already existed and only required to be amplified. To take care of the east coast trade of South America, a station was erected at St. Thomas. This station, which had an initial capacity of 15,000 tons of storage, was opened on October 2. Arrangements have been made for establishing a station at the Azores and another at Bizerta, a small French island off Tunis and located on the ocean highway to the Indies. Material has also been assembled at Manila, where another large storage tank is to be erected.

"Despite what has been done," said J. H. Rosseter, director of the Shipping Board's division of operations, "we feel that we are still at the threshold of the major part of the question, which involves an increase in storage capacity of fuel stations and additional tank steamships for transporting oil to them. We must also take into account the fact that we must now carry oil to our Atlantic seaports, not only from Mexico but from the Texas and Louisiana fields as well. Finally we must awake to the importance of encouraging the establishment of national interest in other known and probable oil regions of the world."

Today the United States possesses a fleet of 486 oil burning steel steamships representing 3,798,733 deadweight tons of new construction. In addition there are 49 freighters of the oil burning type which have been reconveyed by the Shipping Board to their American owners and still another group of 18 which have been sold by the Board and which are under the American flag. Of the 720 steel vessels under construction and contracted for, 636 are oil burners, these aggregating 4,691,659 deadweight tons. When the steel programme has been completed there will be a total of 1,731 vessels of the oil burning type under the American flag.

The total requirements for oil for the United States merchant marine in 1919 have been estimated at 31,000,000 barrels and for the navy and merchant vessels for 1920 at 64,000,000 barrels. The importance of establishing a girdle of oil fueling stations around the world for American ships is therefore obvious.

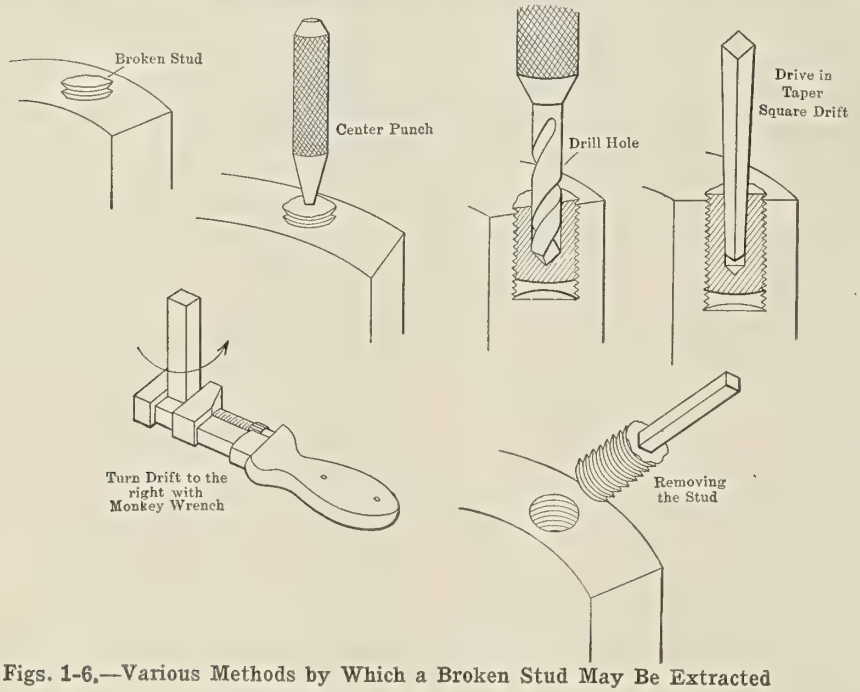
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Removing a Broken Stud

This is a task that is frequently met with, and to old-timers the trick of taking out a broken stud is well known; but today there is reason to believe that a lot of the new young engineers that have come aboard our new merchant ships need to be shown some of the kinks and tricks of the trade. These simple sketches are drawn and described in an elementary fashion for the purpose of clearly conveying the manner in which most all broken studs can be extracted.



Figs. 1-6.—Various Methods by Which a Broken Stud May Be Extracted

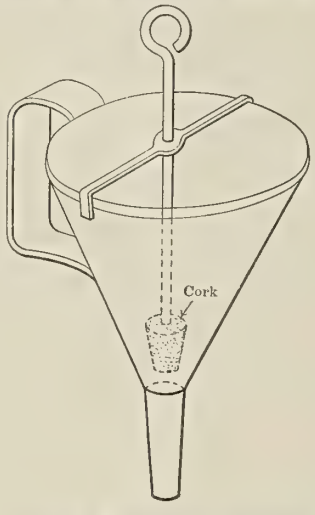
When the stud breaks off close to the part of the casting, so that it is not possible to apply a stillson on it, as shown in Fig. 1, take a center punch and center the stud, as shown in Fig. 2. Next select a drill that is about three-sixteenths smaller than the diameter of the stud and use it to drill out the center of the stud, as shown in Fig. 3, but be sure that you do drill in the center of the stud and that your drill is square with the length of the stud, for if you run off to one side the drill will cut out the threads in the stud hole, thus ruining it. When the hole is drilled, procure a square or any suitable three-cornered taper drift and drive it into the hole in the stud, as indicated in Fig. 4. Then apply a monkey wrench close to the stud on this drift, as shown in Fig. 5, turning to the right, for most all studs are right-hand threaded. The stud will come out on the drift as pictured in the last sketch, leaving the hole threads all right to receive the new stud.

Sometimes when the stud is so small that using a drift is out of question, the stud can be drilled so that nothing but the thin shells of threads are left in the hole and these picked out with a sharp-pointed, small tool. If the stud is of brass, a tap run in carefully will cut out the threads. A very suitable drift for even very small studs or broken screws can be made by grinding the tang of a file.

C. H. Willey.

Funnel Stopper

The simple little home-made kink shown in the sketch has been the means of saving considerable oil in the filling of containers. It always has been the habit of those who fill jugs and cans, etc., with the aid of a funnel, to stop pouring the liquid only when the funnel starts to fill up, then hastily removing the funnel and trying to put their fingers over the spout to save the liquid from spilling.



Simple Device for Stopping the Flow of Oil Through a Funnel

By taking a small length of ⅛-inch round rod, threading it at one end and screwing on this a cork stopper, then making a small bracket to fit across the funnel top, as shown, a means is provided to prevent spilling and waste. When the container is overfilled, the cork is shoved in the spout and then the funnel lifted and emptied. C.

Useful Kinks

While talking with an old engineer recently, he pointed out the height of water in a gage glass of a tank some distance away. The water level showed distinctly but was reddish in color. I remarked on this and he replied that he had found difficulty in reading the glass from a distance. He remedied this trouble by painting a strip of red lead about ¼-inch wide the length of the glass on the

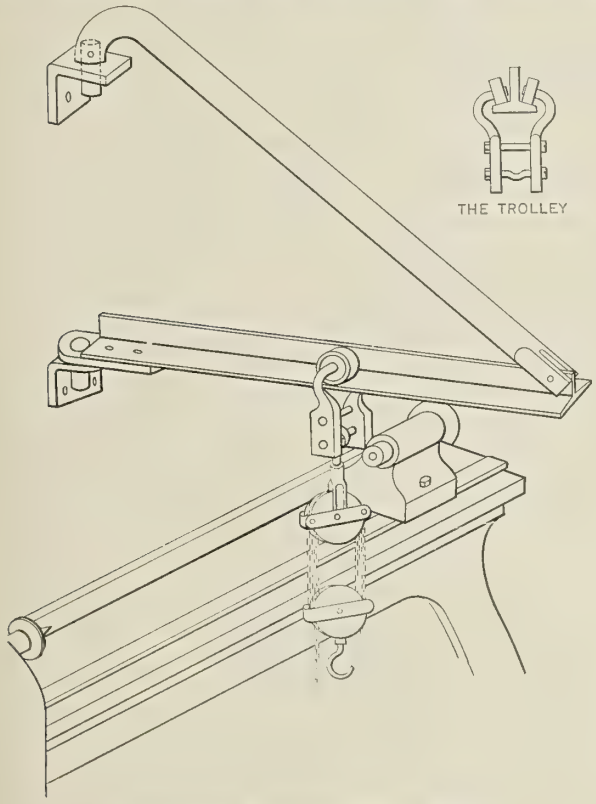
side away from the observer. It was surprising how effective this was in showing the water level at a distance.

An interesting wrinkle in connection with boiling out express boilers was recently adopted by one of our shipyards. The boilers were boiled under one burner, maintaining a low pressure. Then, to aid circulation, the suction end of the auxiliary feed pumps was connected to the bottom blows of the boiler, while the discharge end of the pump was connected to the auxiliary feed valve on the steam drum. This insured proper circulation by pumping the water out of the water drums and back through the steam drums. ENGINEER.

Lathe Swinging Track Crane

This contrivance was built by the ship's blacksmith and the shop men. It is not an elaborate thing, but a rough, home-made one, and yet it seems worthy of describing to other men who may need to improvise a good share of their shop appliances, especially on cargo carriers.

There had always been a need for a small crane that would handle the work that was done in the engine lathe



Convenient Crane for Lathe Work

that was too heavy for the machinist to lift alone; so one day the blacksmith came into the shop to get the shop machinist to do a job for his benefit, and the machinist said, "Sure, we'll swap. I want you to give me a hand to make a small crane for this place, and I'll help you on your work."

The result of their efforts was a simple affair that was both light, strong and handy, as the sketches will show. It consisted of two angle iron brackets, or pedestals, that were drilled for the crane pivot bearings and riveted to the steel bulkhead, a track and vertical arm of 3-inch tee iron, one end of which was riveted to a piece of steel plate that held the pivot piece and the other end of which was secured in the split, and flattened end of a piece of boiler tube 2 inches in diameter. The upper end of this boiler tube was bent at a 45-degree angle and had a short piece of round stock secured into it that set the hole of the pedestal angle plate that was riveted to the bulkhead. A trolley hanger with two wheels was easily made and used on the track, as shown, to hold the tackle for light falls.

This swinging crane was very easy to take down out of the way if necessary, but the idea of making it so that it could be slipped out of its pedestal brackets was so that it could be used in a corresponding set that were riveted to the bulkhead near the ship's small planer or shaper.

MACHINIST'S MATE.

Stud Re-Threading Kink

Occasionally, during making repairs or overhauling machinery, the threads of the studs get burred or bruised, or perhaps they need re-threading to make the nuts go on easier. To do this work without taking out the stud calls

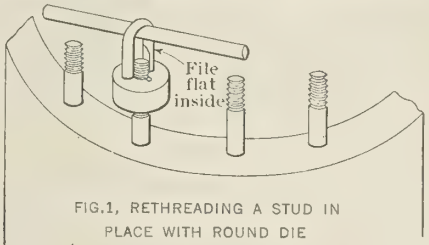


FIG.1, RETHREADING A STUD IN PLACE WITH ROUND DIE

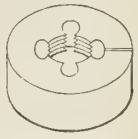


FIG.2, ROUND DIE

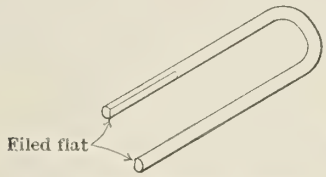


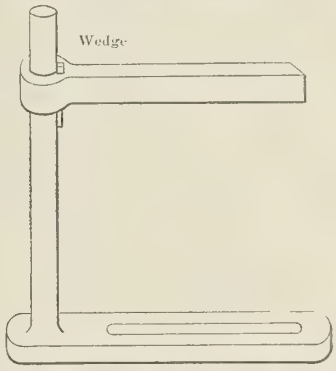
FIG.3 PIECE OF ROD BENT U-SHAPE

A Time-Saving Device

for use of a nut die. It so happened that the writer's plant had only round dies of the type shown in Fig. 2, and to use these an improvised holder was necessary. By making a long U-iron, the work was easily done, as shown in the sketch. HELPER.

Wedged Arm Old Man

By a change of design in the arm hole of the old man drill post, that of cutting a tapered key way and fitting a wedge key, a means was provided that permitted the



A Tapered Key Way and a Wedge Key Hold the Arm of the Old Man at Any Desired Height

ready adjustment of height of this arm without the necessity of a wrench.

To release the arm, the wedge is tapped up, thus loosening it, and again secured by tapping it in place. The old manner of securing the arm on the post with set screws was quite bothersome, as it required a wrench,

often broke off the set screws and marred the post with the point of the set screw. D. P.

Removing Stiff Gage Frames

The usual procedure on the part of the average engine room mechanic when he meets with a gage frame that is frozen on is to take a wrench and, applying it to the rim, try to start it off. This usually dents or mutilates the rim

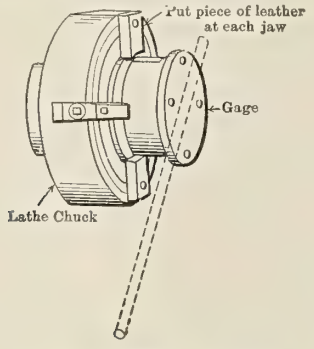


Fig. 1.—Usual Method

and distorts it so that it will not come off, also ruining its appearance. There are two real sensible ways to deal with such stubborn gage frames which are illustrated in the sketches.

One is by putting the whole gage in the lathe chuck and setting up each jaw, placing a piece of leather under

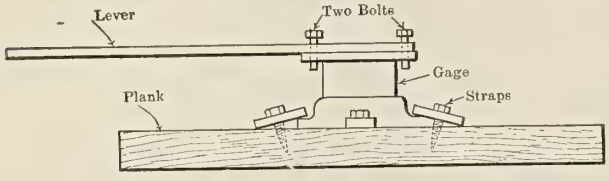


Fig. 2.—Emergency Method

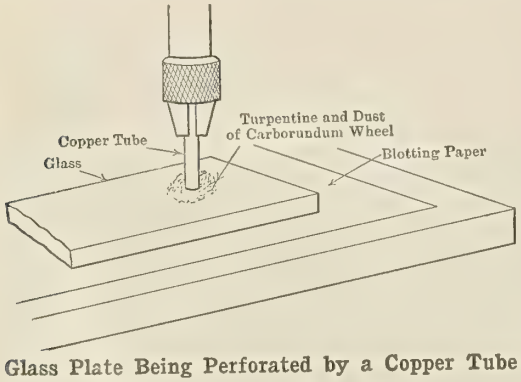
each jaw to protect the rim. By putting in a couple of pins in the bolt holes of the back of the gage and using a lever, the body can be then easily unscrewed.

When no lathe chucks are at hand, the method of fastening the gage frame down to a piece of plank with four straps and small lag screws, shown in Fig. 2, is used.

THE CHIEF.

Drilling a Hole in Glass

The accompanying sketch shows a unique method of drilling a hole in glass by aid of a copper tube, carborundum dust and turpentine. If a steady, even pressure is applied by the drill press, special care being taken when going through the glass, a clean, even hole can be obtained. The sheet of glass should be laid on a pad of blotting paper to obtain the best results.



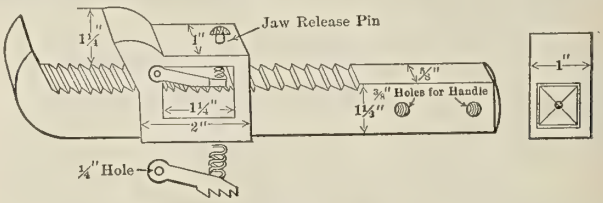
Glass Plate Being Perforated by a Copper Tube

Concord, N. H. CHAS. H. WILLEY.

Handy Wrench for the Tool Kit

The wrench illustrated in the accompanying sketch is quite easily made and has certain advantages of strength and adjustability over the ordinary type of monkey wrench.

It is of a particularly heavy design, but may be made much lighter if required. The shank and jaws are of case-hardened machine steel, while the sliding jaw holder



Quick Adjustable Wrench

is of ordinary hardened tool steel. Special care should be taken that the angle of the jaws is similar to that of an S-wrench, which is about 15 degrees. Either a wooden, pipe or extension handle may be fitted to the shank.

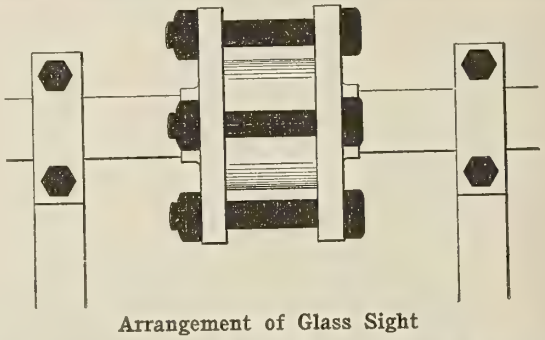
Stillwater, Minn. OTTO DORTHEN.

Sight Glass on Discharge Side of Trap

We had been bothered with feed oil leaking into the feed tank, but could not locate the source of trouble very easily because of the radiator coils, heaters and steam line used for atomizing the galley oil blocking the fuel oil suctions.

To be able to locate the trouble easily and quickly at all times, pet cocks were placed in the drains at each of the five drain traps. However, this did not help matters any, as the attendants were careless and paid little attention to them.

The problem was finally solved by putting a sight glass on each of the drains close to the trap. The attachment is



Arrangement of Glass Sight

nothing more than two 5-inch flanges ½-inch thick, held together by four ½-inch bolts passing through 9/16-inch holes. These flanges are counterbored ¼-inch to receive the rubber gasket and the glass. The glasses are 2 inches long, 2¾ inches in diameter, ¼ inch thick. As the traps are of low pressure, no trouble has been experienced with the glasses leaking or breaking. Brackets support the drain pipe on each side of the glass. Alongside each glass there is placed a nipple of the same size and length as the glass, so that in case of breakage this can be inserted into the tube temporarily. Glasses can be easily removed when it is necessary to clean them, and show at all times whether the trap is functioning properly or not.

JOGOKO.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Piping Systems in Merchant and Naval Practice

Q. (1020).—Please give material of the principal piping systems aboard ships both for merchant and naval practice.

A. (1020).—Below is a list which represents average American practice. There are, however, installations which differ from this list:

	Merchant	*Naval*
Steam Lines		
Main steam.....	Wrought steel or copper	Seamless steel
Auxiliary steam...	Wrought steel	Seamless steel where over 2 inches, copper otherwise
Deck steam.....	Wrought steel or copper	
Exhaust Lines		
Main exhaust.....	Riveted steel	Riveted steel
Auxiliary exhaust.	Wrought steel	Seamless copper
Deck exhaust.....	Wrought steel	
Main escape.....	Copper	Sheet steel riveted
Steam Heating.....	Black wrought steel	
Fresh Water Piping		
Boiler feed.....	Copper	Seamless copper
Evaporator, salt water feed.....	Galvanized wrought steel	Galvanized wrought steel
Drinking and distiller	Galvanized wrought steel	Copper or galvanized wrought steel
Sanitary	Galvanized wrought steel	
Salt Water		
Sanitary service...	Galvanized wrought steel	
Main engine cooling water to bearings	Brass	
Refrigeration		
Ammonia and brine*	Black wrought steel (extra heavy)	
Carbon dioxide...	Black wrought steel	
Fuel Oil†	Extra heavy wrought steel	Seamless steel

* Cannot use brass or copper.
† Cannot use copper.

Bilge and ballast piping in the merchant service may be of galvanized wrought steel, cast iron or lead. Cast iron piping with lead expansion bends is often used. Lead piping is used to connect pump manifolds in the engine room, and same should be thick enough to stand the vibration which is sure to occur here. Sounding and air pipes are, of course, of galvanized wrought steel.

REFERENCE.—"Care and Operation of Naval Machinery," Commander H. C. Dinger, U. S. N.

The Seven Seas

Q. (1021).—What are the seven seas, where did the expression originate, and what is your authority for the same?

A. (1021).—The seven seas are the Arctic, the Antarctic, the North and South Atlantic, the North and South Pacific and the Indian oceans. As to where the expression originated, it is not easy to state. In all probability, since the number seven symbolizes completeness or perfection, it was felt that the creation of the world demanded that number for its completion. Thus the rabbis as early as the beginning of the Christian era affirmed that "God made the seven seas, but the sea of Galilee is His delight." In modern times the phrase is employed both by Fitzgerald (in "Omar Khayyam") and by Kipling. One version of Omar Khayyam (1872), in stanza XLVII, reads: "Which of our coming and departure heeds as the Seven Seas should heed a pebble cast." Kigling (1896) published a book of poems entitled "The Seven Seas." Like not a few other phrases which have come down to us, the parentage is difficult or impossible to trace.

Operating Cost—5,000-Ton Deadweight Steamer

Q. (1025).—Kindly inform me the operating expenses of an American 5,000-ton deadweight steamer.

A. (1025).—Your question might be taken in several ways, due to the meaning of the word "operation" and also the fact that the voyage is not specified. It may be of interest to know that the terms operating and managing are synonymous.

The manager is expected to have charge of all repairs, to see that vessel and equipment are kept in an efficient state, to furnish and pay crew and to store vessel.

The operator must furnish cargo or charter, pay for bunkers, fresh water, also port charges, such as tow-boat hire, consular and agency fees and stevedoring. In fact, the operator has to pay all charges which would be borne by a time charterer.

The operating and managing expenses vary so greatly with length of voyage that it is very hard to give a definite rule. The ratio of loading cost and repairs to total operating and managing cost will decrease with increased length of voyage. In one example known to the writer, in which a vessel was at sea only 45 percent of the total time, the cost for wages and provisions for crew was equal to the cost of fuel, repairs and stores (deck and engine).

The cost of repairs, fuel, crew's wages and food will run into the neighborhood of $450 (93/15/0) per day for this size steamer. It is customary to allow about 15 percent of ship's cost per annum for insurance, depreciation and repairs; split about equally among those three charges.

The figures below give the approximate percentage for some of the different operating charges:

	*	†
Vessels' time steaming total length of voyage (including loading and discharging).....	.53	.62
	Percent	Percent
1. Repairs, insurance and depreciation.....	17	16
2. Boiler and engine room supplies and fuel.	19	32
3. Wages and provisions.....	11	10
4. Harbor dues	32	33
5. Loading charges	15	5
6. Brokerage and office fees.....	6	4

* This vessel's voyage about one-half that of † in length.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—
Engineering Projects—Improved Appliances—Personal Items

MANY TANKER CONTRACTS PLACED DURING THE MONTH

A. G. W. I. Order Eight Vessels —Other Companies Asking Bids

The Shipping Board statement that the tanker shortage for the coming year would be at least 1,000,000 tons is verified by the number of private ship contracts for tanker tonnage which have been placed during the last month. The largest contract was placed by the Atlantic Gulf and West Indies Steamship Lines, 11 Broadway, New York. Two of these vessels, of 10,600 tons each, will be built by the Sun Shipbuilding Company, Chester, Pa. The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., holds an order for four of the tankers of 12,600 tons each, and the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., an order for two tankers of 14,800 tons each.

The National Oil Company, Woolworth building, New York, has just launched a 6,000-ton oil tanker at the company's yard in Orange, Tex. A second tanker of similar tonnage and design, equipped with Diesel engines, is also being built for the company's own account.

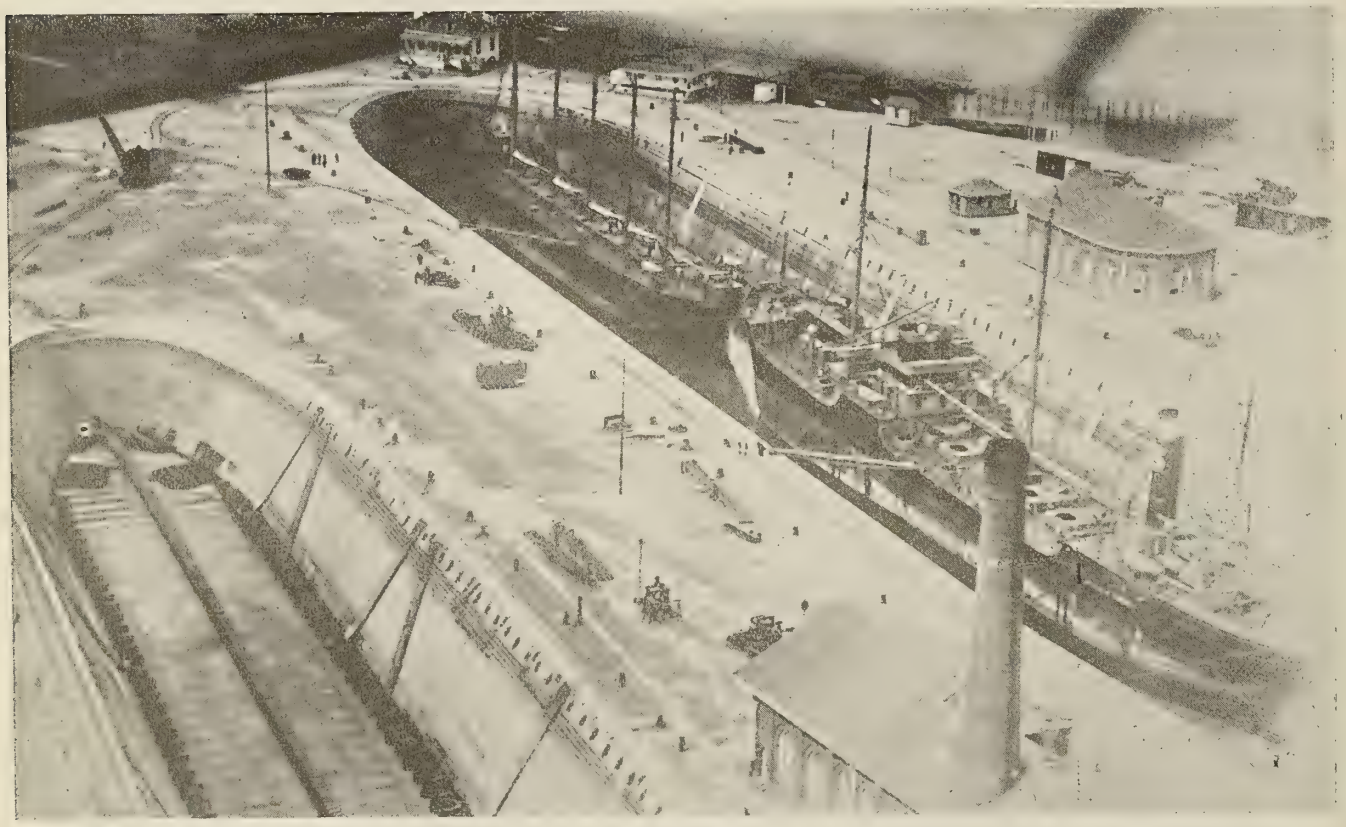
In addition to the contract for three tankers which has been placed with the Bethlehem Shipbuilding Corporation, Ltd., the Pan-American Petroleum and Transport Company, Los Angeles, Calif., and 120 Broadway, New York, is in the market for three more oil tankers. The Vacuum Oil Company, 61 Broadway, New York, which has also recently placed an order for one tanker with the Bethlehem Shipbuilding Corporation, Ltd., is in the market for two oil tankers, and the Cities Service Company, 60 Wall Street, New York, is now negotiating with several shipyards for the construction of two tankers. The Sinclair Consolidated Oil Corporation, 120 Broadway, New York, which has recently placed two new tankers in service, is also in the market for additional tankers at favorable prices.

The rumor that the Texas Oil Company, 17 Battery Place, New York, has purchased six tankers, as recently published, is denied by the company. The statement was probably based on the fact that the company was asking prices on tanker tonnage.

PRIVATE CONTRACTS AND REINSTATEMENTS EXCEED 348,400 TONS

Further Navy Contracts Placed

Many contracts for special tonnage are now being placed by private companies. The Crowell & Thurlow Steamship Company, 131 State street, Boston, Mass., has placed a contract for a 9,600-ton steamship with the Bath Iron Works, Bath, Me. John S. Emery & Company, 114 State street, Boston, Mass., is still negotiating for the purchase of ten 10,000-ton vessels, which are now partly completed in a California yard. The Bethlehem Steel Company, South Bethlehem, Pa., plans to build in its own yards fifteen large steamships to carry oil to South America and handle ore on the return voyage. The Shawmut Steamship Company, 60 Federal street, Boston, Mass., has placed an order for two 10,500-ton freighters with the Chester yard of the Merchant Shipbuilding Corporation, Chester, Pa. The Newburgh Shipyards, Inc., Newburgh, N. Y., will build two 7,500-ton vessels for the Union Sulphur Company.



(Photograph by Underwood & Underwood, N. Y.)

View of the Two Graving Docks Now Operated by the Bethlehem Shipbuilding Corporation at Hunter's Point, Cal. The Larger Dock is 1,096 Feet Long, Including Caisson; Only a Portion of the 730-Foot Dock is Shown in the Photograph

On Government contracts several reinstatements have been announced. The Groton Iron Works, Groton, Conn., has received a reinstatement on six 8,800-ton steel vessels from the Shipping Board. The Southwestern Shipbuilding Company, San Pedro, Calif., according to a statement reported to have been issued by Marco H. Hellman, president of the Company, has secured a contract involving $20,000,000 from the Emergency Fleet Corporation. These vessels it is reported, ten in all, will be operated between the Pacific coast ports and Boston.

On navy work, the Norway Pacific Construction and Dry Dock Company, Everett, Wash., is about ready to close a contract for several vessels. This work is in addition to the contract for five 1,600-ton revenue cutters already received. The Fore River yard of the Bethlehem Shipbuilding Corporation, has received a contract for six type *S* submarines through the Electric Boat Company, 11 Pine street, New York. The American International Shipbuilding Corporation, Hog Island, Pa., has received orders to finish twelve 8,000-ton vessels on contract No. 83 as transport ships.

Prospective Ship Contracts

In addition to the outstanding bids for tanker tonnage, reports show that many private companies are about ready to place contracts for other special ship construction. N. E. McClelland, a naval architect, located at 2 Stone street, New York, is in the market for twenty 165-foot steel three-masted schooners of 850 to 900 deadweight tons each. Theodore E. Ferris, naval architect, 30 Church street, New York, is preparing plans and specifications for two freight steamers to be built for the Eastern Steamship Lines. He is also working on plans for converting seven vessels of these lines into oil burners. Two 415-foot fruit vessels with a speed of 17 knots are being designed by William Gardner, 1 Broadway, New York.

On the West coast, a man by the name of Moore, located in Seattle, Wash., has organized a company to build a fleet of twenty freighters of 10,000 tons each. The Pacific Mail Steamship Company, 508 California street, San Francisco, Calif., proposes to place four new trans-Pacific liners in service.

Lord & Curtis, 32 Regent street, London, according to a cable from the American Attache at London, are in the market for ten 6,000-ton cargo steamers and three passenger steamers from 2,000 to 3,000 tons.

Capacity of Hunter's Point Drydock

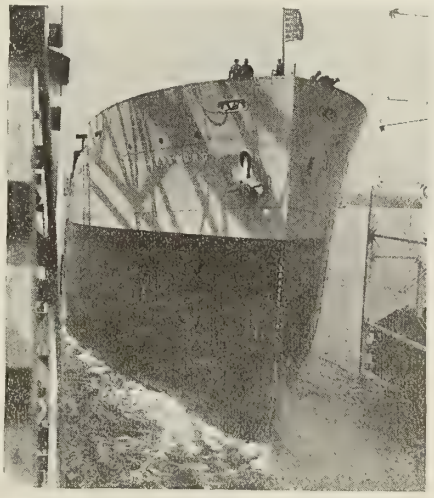
Joseph J. Tynan, general manager of the Bethlehem Shipbuilding Corporation, Ltd., Union Plant, San Francisco, Cal., has announced that the new concrete drydock at Hunter's Point, San Francisco, Cal., is large enough to handle any of the six cruisers it is proposed to dispatch to Pacific waters upon completion. The length of the dock, clear of caisson, is 1,000 feet, and the breadth on coping 153 feet. The depth on sides is 48½ feet and the bottom breadth is 110 feet.

Two Large Ore Carriers and Ten Ocean Vessels to Be Built on the Great Lakes

The American Ship Building Company, Cleveland, Ohio, it is understood, has received orders for two large ore carriers and ten vessels of the Welland Canal size, which will be used in the Atlantic Ocean service.

New Pattern Shop for Norfolk

The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning the construction of a pattern shop at the Norfolk Navy Yard.



Launching the 436-Foot Freighter Scottsburg at the Yard of the New York Shipbuilding Corporation, Camden, New Jersey

Allotment of Pacific Fleet

The Government Navy Yard at Bremerton, Wash., has been designated as the home yard for eighty-four vessels of the Pacific fleet, including all vessels of the super-dreadnaught type. This does not assure, however, that all repair work, overhauling and supplying for this vast fleet will be handled through the Bremerton yards. Mare Island Navy Yard will serve as the home yard for forty-eight ships of the second line, also smaller craft.

The Cleveland Crane & Engineering Company, Wickcliffe, Ohio, has received a contract to install wall cranes in the Mare Island structural shop. About $103,000 is involved in the work. Manning, Maxwell & Moore, 119 West Fortieth street, New York, have received a contract for similar work which will cost $94,876.

Fluctuation in Sale Price of Sailing Vessels

The Standard Oil Company has recently sold two large sailing vessels to the Robert Dollar Company for $520,000. Several years ago one of the vessels, the *Dunsyre,* was purchased for $18,000. During the war period it was sold for $140,000, and later to the Standard Oil Company for $250,000. Both vessels are steel and were built about twenty-eight years ago at Glasgow, Scotland.

ENGLISH SHIPYARDS HOLD CONTRACTS FOR FIVE AUSTRALIAN VESSELS

Australian Shipbuilding Programme

William Beardmore & Company, Dalmuir-on-the-Clyde, has received a contract from the Australian Government for two cargo steamers of 22,500 tons each. The vessels will be 530 feet between perpendiculars, 68-foot beam and 43 feet 6 inches molded depth. Three vessels of a similar size are to be built by Vickers, Ltd., Barrow-in-Furness. Report has also been received that six 12,000-ton vessels will be built in Australia for the Government.

Vessels of 5,000 and 6,000 tons are now under construction at West Point and Cockatoo Island for Government service. Although Australian Government shipbuilding has up to the present time proved profitable, English steamship operators feel that the situation will remain so only temporarily.

The Canadian Government Shipbuilding Programme

The Canadian Government shipbuilding programme calls for vessels of three types—one, two and three deckers—and in seven sizes. Two are to be 2,800 tons each, four 3,400, five 3,750, eight 4,300, eight 5,100, sixteen 8,100 and two 10,500.

The ships are being constructed in Halifax, New Glasgow, Levis, Three Rivers, Montreal, Kingston, Welland, Collingwood, Port Arthur, Prince Rupert, Vancouver and Victoria. The total deadweight will be about 256,000 tons. The total cost will be $52,000,000. The service will be operated by the Canadian National Railways.

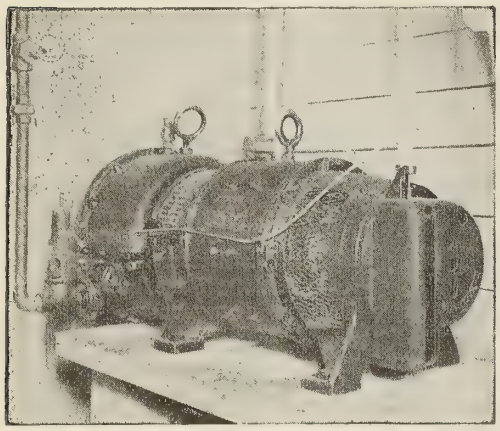
Report on Japanese Shipbuilding Estimates $187 as Cost Per Ton

A report forwarded from Tokio states that 3,000 men have been laid off at the Osaka Dock Yard. At the meeting of the directors the president explained that a recent loss of 3,620,000 yen had been sustained. The Kawasaki Dock Yard still retains contracts for three cruisers and two destroyers for the Japanese navy, five steamers for United States interests, and thirty vessels from 6,800 to 9,100 tons. At present it costs $187 per ton for steel cargo carriers built in Japan, and S. Hirota, manager of a Japanese steamship company, reports that the continual increase in cost may force Japanese interests to construct vessels in this country where steel may be obtained more cheaply.

Compact Electric Turbo-Generator

A compact electric lighting turbo-generator, which is especially adapted for use on tugboats and small harbor and river craft, has been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

This generator has a capacity of 7½ kilowatts, generates direct current at 250 volts, and has sufficient power to provide



Westinghouse Turbo-Generator

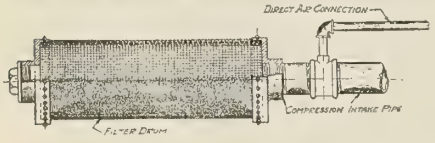
current for fourteen incandescent lamps and a searchlight.

In a recent installation on a United States Government tugboat an impulse-type steam turbine and an electric generator were combined to form this single compact unit. The plant will take steam at from 70 to 225 pounds' pressure directly from the boiler without a reducing valve. The exhaust steam, if it is operated non-condensing, is free from oil and can be used for heating purposes. The speed is 4,000 revolutions per minute; the use of an automatic governor prevents over-speeding.

Practical Cloth Air Filter

One of the simplest means to prolong the life of tools, as well as the compressing equipment, is proper cleansing of the air supply at the compressor intake.

A study of the pneumatic tool situation at one of the large shipyards showed that the foreign matter carried in the air was of such a nature as to practically



Practical Cloth Filter

preclude the use of the small wire gauze strainers. The operators arbitrarily remove the strainers on account of the delays which they cause.

Cloth filter screens, if properly designed, will clean the air to a very large extent. The larger the filtering area the closer the grade of cloth that can be used, and the more perfect the filtration.

Tests made by the standard practice branch of the Emergency Fleet Corporation show that air will pass through a light grade of unbleached muslin at the rate of 100 cubic feet per minute per square foot of area, when subjected to a suction pressure of approximately 1/100 of a pound.

It is possible to extend the suction pipe outside of the building in the form of a drum, constructed of heavy wire netting, as indicated by the accompanying sketch. The filter cloth can be placed around the drum.

If a supporting layer of poultry wire is secured around the outside of the cloth, cleaning can be conveniently accomplished by admitting a volume of high-pressure air directly into the intake pipe, and reversing the flow through the cloth at intervals when the compressor is not in operation.

A Small Electric Light Plant Equipment

An outgrowth of the small turbo-generator sets installed in locomotives for headlight service is embodied in the new Buda-Ross electric light plant equipment made by The Buda Company, Railway Exchange building, Chicago, Ill. The unit is intended for small industrial plants using boilers, for steamboats, dredges, steam shovels, and for similar lighting purposes where the requirements do not exceed 1 kilowatt.

The outstanding feature of this type of lighting plant is the unusually small size for a steam turbo-generator plant (the two sizes available are of ½ kilowatt and 1 kilowatt capacity).

Special automatic governors control the speed, while the field coils of the generator have compound winding, which keeps the voltage uniform over the lighting circuits. The operation is thus made entirely automatic except for the turning on of the steam when the lights are needed.

Forged Cutter Tool Holders

J. H. Williams & Company, Brooklyn, N. Y., have recently produced the "Vulcan" forged cutter tool holders as an addition to their line of "Agrippa" tool



New Vulcan Tool

holders. It is claimed that this holder makes possible the use of what is practically a solid tool without its expense.

Each holder by the insertion of a small high-speed steel forged cutter is made suitable for service in any regular machining operation on the lathe, planer, cutter, etc. The holders are drop-forged from a fine grade of steel and heat-treated to develop maximum toughness and stiffness. They are simple in construction, being composed of three parts—the holder proper, a square-head cam and a locking pin. "Agrippa" drop-forged high speed steel cutters are available in a wide range of sizes and types—side tool, diamond point, roughing, hog nose, flat nose, threading, etc.



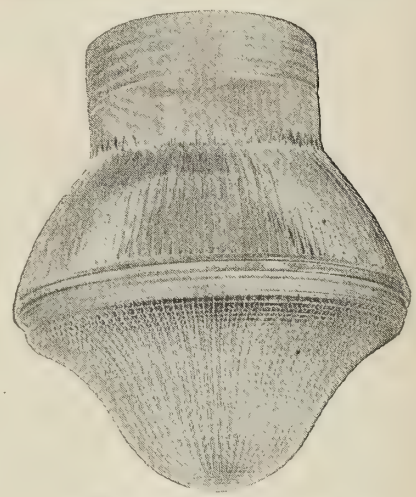
Special Cutter

Advantages of the Free Port of Copenhagen

American exporters have been advised by Roger Neilson, of the Danish legation, that goods may be stored in Copenhagen's storehouses free of rent for two weeks in the care of the Copenhagen Free Port Company, which is in a position to issue warehouse warrants upon which the merchants can raise loans at Copenhagen banks.

Vapor Proof Reflector Globe

By using the prismatic construction the Holophane Company, 340 Madison avenue, New York, has designed a combined vapor-proof globe and reflector. The reflecting prisms on the upper portion of the globe redirect the light downward; refracting and diffusing prisms on the lower surface distribute the light in different directions in the desired proprotions. The company states that tests show that the illumination is increased 75 percent over that produced by the ordinary clear vapor-proof globe. These globes are made for 40 and 60-watt type B lamps and for 75, 100 and 150-watt type C lamps now in use in connection with the standard vapor-proof fittings, including the standard navy thread.



Vapor Proof Reflector Globe

Gear Cutting Exhibit

A novel exhibit of gear cutting was held recently on one of the principal streets of Cleveland by the Van Dorn & Dutton Company of that city.

The object of this demonstration of the use of machine tools and gear cutting was to give the public an idea of modern production methods in this connection and of the extent and application of the gear cutting industry. Special types of gearing for electric cranes, hoists, mill machinery, bevel, spiral rack and pinion, sprocket and the like were shown.

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects Launchings—Government Contracts

SHIP CONTRACTS

The American International Shipbuilding Corporation, Hog Island, Pa., has received orders from the War Department to finish twelve 8,000-ton deadweight vessels, keels for which have already been laid under contract No. 83, as transport ships. The vessels are standard type, 448 feet on the load waterline, 58 feet beam and 40 feet depth with an estimated speed of fifteen knots. Each vessel will be fitted with six watertube boilers and geared turbines of 6,000 shaft horsepower. It is expected that these vessels will be completed by May 1, 1920.

The Atlantic Gulf & West Indies Steamship Lines, 11 Broadway, New York, has placed contracts for eight oil tankers. Two of these, of 10.600 tons each, will be built by the Sun Shipbuilding Company, Chester, Pa. The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., holds an order for four tankers of 12.600 tons each and the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., an order for two tankers of 14.800 tons each.

The Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., has received a contract to recondition the British steamship *Eurana* of the Green Star Line. The company has also received a contract to fit the motor tanker *Brammel Point* with Diesel engines. This vessel, of 4,990 deadweight tons, was launched at the company's yards in 1916, equipped with three Bolinder engines.

The Bath Iron Works, Bath, Me., has received a contract for one 9,600-ton steamship from the Crowell & Thurlow Steamship Company, 131 State Street, Boston, Mass.

The Cairo Wood Products Company, Cairo, Ill., which holds a contract to build 35 barges, five of which are 145 feet by 34 feet by 7 feet, and twenty-five 130 feet by 26 feet by 7 feet, is constructing this tonnage of long leaf yellow pine lumber and timbers. The barges contain seven transverse bulkheads and two longitudinal bulkheads and are fitted with pumps and piping, as well as electric wiring. The company also expects to begin building shortly eight large barges for handling stone and gravel.

The Cammell-Laird Company, Birkenhead, Eng., has received a contract from the French Ministry of Marine for the construction of a passenger and mail steamer for service between Marseilles and Northern Africa. The propelling machinery will be of the double reduction geared turbine type, with cylindrical boilers for coal and oil burning.

The Clooney Construction & Towing Company, Westlake, La., has received a contract to build five barges for the Western River Service.

The Compagnie General Transatlantique, with New York offices at 19 State Street, has placed contracts for 300,000 tons of new ships, according to a statement issued by John Dal Piaz, managing director of the company. N. Claveille, minister of maritime transport, Paris, France, has announced, after careful examination of all the contracts, that French shipowners have already placed orders either in France or abroad for over 1,000,000 gross tons of shipping.

The Cubitt Shipbuilding and Dry Dock Company, Chiswick, England, has received an order for two concrete motor coasters.

The Donaldson Steamship Company, 17 Battery Place, New York, has ordered six steamers for the Atlantic trade. The Anchor-Donaldson Line, has ordered two vessels for the Glasgow and Montreal route. Seven of these vessels will be constructed in the Clyde yards; the other vessel will be built at Barrow-in-Furness.

The Electric Boat Company, 11 Pine Street, New York, has placed a contract with the Fore River Yard of the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., for six type *S* submarines. When this is completed 18 vessels of this type will have been constructed at Fort River.

William Beardmore & Company, Dalmuir-on-the-Clyde, has recently received a contract from the Australian Government for two cargo steamers of 22,500 tons each. The vessels will be 530 feet between perpendiculars, 68-foot beam and 43 feet 6 inches molded depth.

The Bethlehem Steel Company, South Bethlehem, Pa., plans to build in its own yards 15 large steamships for its own use to carry oil to South America and bring back ore.

John S. Emery & Company, 114 State street, Boston, Mass., is still negotiating for the purchase of ten 10,000-ton vessels which are partly completed in a California shipyard. The Shipping Board has made no announcement confirming the transaction.

The Groton Iron Works, Groton, Conn., has received a reinstatement on six 8,800-ton steel vessels on a previous contract received from the Shipping Board.

Harland & Wolff, Belfast, Ireland, has received a contract from the British & Irish Steam Packet Company, for two 300-foot passenger vessels, designed to make 16 knots.

Hodgdon Brothers, East Boothbay, Me., have received a contract to build an auxiliary schooner of about 85 feet at the waterline for arctic exploration work by Professor Donald B. MacMillan of Bowdoin College. The vessel will cost about $20,000.

The B. P. Lanteri shipyards, Pittsburgh, Cal., have received a contract from the Monarch Dredging Company, Benecia, Cal., to build a concrete and wood dredger to cost about $125,000. The hull and deck of this craft will be of steel and concrete. The bottom will be made of wood.

The Larne Shipbuilding Company, Ltd., Antrim, England, according to a recent report, has received contracts for several steel screw cargo steamers of 600 tons each.

P. Jesse Matton, Watervliet, N. Y., has received a contract to build eight barges for New York parties. These boats will have a displacement of about 750 tons.

The National Oil Company, Woolworth building, New York, has just launched a 6,000-ton oil tanker at the company's yard in Orange, Texas. A second tanker of similar tonnage and design, equipped with Diesel engines is also being built for the company's own account.

The Newburgh Shipyards, Inc., Newburgh, New York, holds a contract for two vessels of 7,500 tons deadweight from the Union Sulphur Company, 17 Battery Place, New York. This publication announced the placing of the contract for one vessel last May. These vessels will be equipped with geared turbines driving twin screws, the shafts being led through patent bilge tunnels on the Simpson-Gordon principle. The ships, which will be 375 feet overall, will be equipped to burn oil.

The Norway-Pacific Construction and Drydock Company, Everett, Wash., is about ready to close a contract for several Government vessels. This work is in addition to the contract for five 1,600-ton revenue cutters already received. As soon as details are arranged regarding this construction, full information will be given out by **M. G. Thomle**, president of the company.

The Pan American Petroleum & Transport Company, Los Angeles, Calif., and 120 Broadway, N. Y., has placed a contract for three tankers with the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.

The San Francisco Shipbuilding Company, Oakland, Cal., according to a statement issued by V. H. Poss, has received a cancellation on three concrete vessels.

The Shawmut Steamship Company, 60 Federal street, Boston, Mass., has placed an order for two 10,500-ton freighters with the Chester yard of The Merchant Shipbuilding Corporation, Chester, Pa.

PROSPECTIVE SHIP CONTRACTS

Extensive Ocean Tonnage, New York.—The American Ship & Commerce Company, the holding corporation of the Kerr Steamship Company, 17 Battery Place, New York, is about ready to close a contract for foreign ship tonnage. The company has $10,000,000 available for this purpose.

Four Ocean Steamers, San Francisco.—The Pacific Mail Steamship Company, 508 California street, San Francisco, Cal., it is announced, proposes to place four new trans-Pacific liners in service, each to have accommodations for 300 first, 150 second class and 1,500 steerage passengers.

Tankers, New York.—The Sinclair Consolidated Oil Corporation, 120 Broadway, New York, is in the market for additional tankers. Two large tank ships have recently been placed in service.

Ten 6,000-Ton Vessels and Three Passenger Steamers, London.—Lord & Curtis, 32 Regent street, London, are in the market for ten 6,000-ton cargo steamers and three passenger steamers from 2,000 to 3,000 tons, according to a cable from the American Attaché at London. If American shipping companies are interested they are asked to cable quotations direct to the firm named.

Three Oil Tankers, Los Angeles, Cal.—The Pan American Petroleum & Transport Company, Los Angeles, Cal., is in the market to place orders for three large oil tankers.

Twenty Steel Three-Masted Schooners, New York.—N. E. McClelland, 2 Stone street, New York, is in the market for unnamed clients for twenty steel three-masted schooners of 850 to 900 deadweight tons each. These vessels will be 165 feet overall, with a beam of 35 feet and molded depth of 14 feet 6 inches. Delivery on these vessels is required in two years' time or less.

Twenty 10,000-Ton Freighters, Seattle, Wash.—It is understood that a man named Moore, Seattle, Wash., has organized a company to build a fleet of twenty freighters of 10,000 tons each.

Two Large Tankers, New York. — The Cities Service Company, 60 Wall street, New York, is in the market for two large tankers of about 10.600 tons.

Two Oil Tankers, New York.—The Vacuum Oil Company, 61 Broadway, New York, is in the market for two large oil tankers.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Drydock, Brooklyn, New York.—The Morse Dry Dock & Repair Company, Brooklyn, New York, now operates a floating drydock equipped to handle 625-foot vessels of over 24,000 tons. When the sixth section is completed, vessels 725 feet long can be accommodated.

Drydock, Clyde, Scotland. — Messrs. Barclay, Curle & Company, Ltd., Whiteinch, are negotiating to build a graving dock at Elderslie on the Clyde. If the permission of the Clyde trustees is granted a drydock 600 feet in length will be constructed. It is rumored that the delay on the part of the trust in giving approval to this plan for new construction may perhaps be due to the fact that the men composing the trust are not anxious to permit the laying out of a rival dock so near to their own proposed installation.

Drydock, Quincy, Mass. — The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., has awarded a contract to M. M. Davis & Son, Inc., Solomons, Md. to construct ten wooden pontoons, 116 feet long, 41 feet wide and 13½ feet deep, which will be towed to the Fore River yard at Quincy, Mass., where they will form a 10,000-ton drydock. Arrangements have now been completed by which the Commonwealth of Massachusetts will rent to the Bethlehem Shipbuilding Corporation at a nominal rent of $1 per year, 600,000 square feet of land adjoining the premises of the Fore River plant. This opens the way for the construction of a large drydock by that company, which, as previously announced, will cost between $2,000,000 and $4,000,000.

Drydock, Vancouver, B. C.—J. Coughlan, of J. Coughlan & Sons, Vancouver, B. C., has announced that the company is willing to finance the construction of a large graving dock at the port of Vancouver under the Canadian Drydock Subsidy Act. The dock will be operated by the company for repair work.

Marine Manufacturing Building, New York.—Charles Cory & Son, 290 Hudson street, New York, manufacturer of ships' bells and electrically-operated marine apparatus, is preparing to construct a six-story reinforced concrete addition to cost about $200,000.

Marine Manufacturing Company, Syracuse, N. Y.—The Inland Marine Corporation, Syracuse, N. Y., was recently incorporated with a capital stock of $100,000, to manufacture marine equipment. D. E. Alvord, B. E. Shove and M. S. Melvin are the incorporators.

Marine Railways, Dredging, Etc., Tampa., Fla.—The McElroy Engineering Company, Tampa, Fla., holds a contract for work to be carried out for the Winter Haven Lake Boat Course District Commissioners, including the building of two marine railways, dredging, etc.

Pattern Shop, Norfolk, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning the construction of a pattern shop at the Norfolk Navy Yard.

Railway Drydocks, Burin, Newfoundland.—The Western Marine Railways, Ltd., has contracted for the construction of two railway timber drydocks at Burin, Newfoundland. The larger of these docks will measure 170 feet over the keel blocks, and will be capable of handling vessels up to 1,000 tons displacement. The other drydock will be able to handle two vessels of 300 tons displacement. The Crandall Engineering Company, East Boston, Mass., will design and construct these railways.

Railway Drydock, Baltimore, Md.—The Union Shipbuilding Company, Baltimore, Md., is about ready to begin the construction of a railway drydock capable of handling vessels up to 4,000 tons displacement. This drydock will be 316 feet over the keel blocks with a draft of 20 feet. The Crandall Engineering Company, East Boston, Mass., has designed the dock and will superintend the work.

Sheet Metal Products for Drydocks, New York.—The Drydock Sheet Metal Works, 140 West 42nd street, New York, has acquired property at 509 East 80th street. The company plans to construct a new three-story plant on the tract.

Shipbuilding Company, Alberni, B. C.—The Port Alberni Shipbuilding Company, Ltd., has recently been organized with a capital of $100,000 for shipbuilding purposes. The registered office is given as Alberni, B. C.

Shipbuilding Company, Dublin, Ireland.—The Irish Shipbuilders, Ltd., a new shipbuilding corporation located at Dublin, Ireland, has booked two orders from a Belfast concern. The yard which is seven acres in extent includes five shipways, three of which will accommodate 300-foot vessels.

Shipbuilding Company, New York. — The Monofer Shipbuilding Company, New York, has recently been incorporated with a capital of $30,000, by J. L. Druck, L. F. Sniffen and F. Kweton, 49 Wall street, to build ships of cast steel, under license of the Cast Steel Ship Corporation, 114 Liberty street, New York.

HARBOR IMPROVEMENTS

Barge Canal Terminal, East River, New York.—The New York State Barge Canal Terminal, costing over a million dollars, has been opened at Pier 6, East River, New York. The appropriation for this construction was available eleven years ago after the passage of the Barge Canal Terminal act which provided for the issuing of $19,800,000 in bonds for the construction of canal terminals.

Bulkhead, Norfolk, Va.—The standard Oil Company is negotiating through City Manager Ashburner, Norfolk, Va., for the construction of a bulkhead at the port by a joint agreement. The whole work will cost the city about $250,000.

Concrete Pier, Bridge and Ferry Slip, Bay Shore and Rock Hall, Md.—The Baltimore & Eastern Shore Ferry Line, S. A. Tubman, vice-president and manager, Room 613 Lexington building, Baltimore, Md., plans to construct a 1,000-foot reinforced concrete pier with bridge and ferry slip at Bay Shore and at Rock Hall, Md. M. D. Swartz, Madison avenue and Preston streets, Baltimore, is the engineer, and the Raymond Concrete Pile Company, Baltimore, is the contractor. The company has also purchased two double ferryboats.

Completion of Army Terminals, Philadelphia, Pa.—The army terminals, located at Philadelphia, Pa., upon which work was begun in August, 1918, will be completed by December 1. These three adjacent piers equipped with the most modern handling and storage facilities had been built at the expenditure of $13,000,000.

Docks, Berkley, Va. — M. Block and L. Shefsky have purchased the Fosburgh Lumber Company, Berkley, Va., and plan to spend about $75,000 in providing docking facilities for large vessels.

Harbor Improvements, Mobile, Ala.—William T. Donnelly, consulting engineer, 17 Battery Place, New York, has submitted a report to the Harbor Board of the State of Alabama, advising the expenditure of $5,000,000 over a five-year period upon part improvements at Mobile. This work, as outlined, would include the building of a 1,240-foot bulkhead for $200,000, the erection of a four-story concrete warehouse for $1,250,000, as initial construction. He advised the building subsequently of 800-foot piers with fireproof sheds at an estimated cost of $1,250,000 each. He recommended that the relocation of railroads be carried out to facilitate freight handling and that all shipping developments be built above the Gulf storm level. Further action will depend upon securing State appropriations for this improvement at Mobile.

Harbor Improvements, Portland, Maine.—At a recent special election the voters of the state of Maine authorized a bond issue of $2,000,000 to be used for a state steamship pier at Portland, Maine, and an interstate bridge across the Piscataqua river.

EQUIPMENT WANTED

Freight Handling Machinery, Portland, Ore.—G. B. Hegardt, chief engineer of the Portland Dock Commission, Portland, Ore., is considering the installation of a system of mechanical freight carriers similar to those in operation at Duluth, Minn.

Freight Handling Machinery, Stapleton, Staten Island, N. Y.—C. J. Hogstett, technical department, Pan-American Terminal and Dock Corporation, Woolworth Building, New York, advises us that this company has distributed blue prints of its two new piers at Stapleton, Staten Island, to machinery manufacturers in order that they might offer suggestions as to the class of machinery best suited for the most efficient handling of freight at this point. No specifications have as yet been issued. This company has stated that it has contemplated an installation of at least 34 cranes.

Machine Shop Machinery, Puget Sound, Wash. — The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is receiving bids on various kinds of machine shop machinery to be installed at the Puget Sound Navy Yard.

Mechanical Freight Handling Facilities, Gantry Cranes and Special Appliances, New York City.—Isbrandtsen, Moller & Company, Woolworth Building, New York City, who have leased two piers from the city of New York, plan to have these piers furnished with all modern mechanical freight facilities, including gantry cranes and special appliances. Distributing and tiering of inbound freight will be handled mechanically.

Motor-Driven Bolt Threading Machine and a Bar-Iron Rivet Shearing Machine, Brooklyn, N. Y.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is receiving bids on one motor-driven bolt threading machine and one bar-iron rivet shearing machine, to be installed at the New York Navy Yard, Brooklyn, N. Y.

Tools, Hardware, Concrete Machinery, Structural Iron and Steel, Office Supplies, etc., Roumania.—The Belgrade Consulate, K. S. Patton, consul, Belgrade, Roumania, seeks catalogues of tools, hardware, concrete machinery, structural iron and steel, office supplies electrical equipment and machine tools.

SURPLUS MATERIAL FOR SALE BY GOVERNMENT

Sheets, Plates, Shapes, Bars and Fabricated Structural Material.—The United States Shipping Board Emergency Fleet Corporation, 140 North Broad street, Philadelphia, Pa., requests bids on 3,000 tons of sheets, 7,000 tons of shapes, 20,000 tons of plates and 2,500 tons of bars. Details can be obtained from the above offices or at the district sales offices of the Supply and Sales Division.

Ship Machinery, Boilers, Steel Shapes, etc.—The United States Shipping Board Emergency Fleet Corporation, Washington, D. C., has for sale at its warehouse, surplus shipbuilding materials, including machinery, boilers, deck machinery and equipment, valves and fittings, electrical equipment, refrigerating outfits, cargo handling machinery, steel shapes and miscellaneous material. Further information will be supplied by the Sales Section, Supply & Sales Division, United States Shipping Board, 140 North Broad street, Philadelphia, Pa.

Steam Engines, Derricks, etc. — The Director of Sales of the War Department announces that the Surplus Property Division of the office of the Quartermaster General is offering for sale, by negotiation, construction equipment including steam engines, derricks, generator sets, gas engines, steam boilers, etc., valued at $900,000.

INTERNATIONAL

Marine Engineering

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Fig. 1.—Partial View of Morse Dry Dock and Repair Company's Yards Showing the Arrangement of the Principal Shops, Docks, Plate Storage and Material Storage Spaces

The Morse Dry Dock and Repair Plant

Not least among the factors which have contributed to the success of the American shipping programme during the past two years has been the work of the repair yards along the coast. Of these, the Morse Dry Dock and Repair Company, of Brooklyn, N. Y., has rendered valuable service in keeping the army transports and supply ships in commission. Efficient organization methods, together with the support and co-operation of the men, have combined in making this plant an excellent one for turning out repairs rapidly.

THE foundations of the Morse Dry Dock and Repair Company's organization were laid about 1880, when E. P. Morse started a small ship-repair plant near the present site. For ten years the business progressed and the reputation of the company became established among shipowners and operators in the port of New York. In 1890 came the first setback, when the entire plant and equipment were destroyed by fire. Without great delay a new company was organized and soon regained the position held by the parent enterprise. During this period the company's first dry dock was built and put in operation.

Expansion was rapid and until 1903 no further trouble was experienced. At this time, however, a series of strikes closed the shops entirely and not until 1904 was the yard able to continue production on the open shop principle of labor, which has subsequently proved successful.

Policy of Expansion

Ten years ago a policy of building expansion was inaugurated, in order that equipment might keep pace with the business. Ships of all types and in all stages of repair were finding their way to the yard to be made seaworthy and the existing facilities of the plant were taxed to the utmost to accommodate them. Under the impetus of war needs the building programme was increased and went forward without interruption.

Temporary structures were put up to house the various departments during this expansion period, and as soon as a definite idea of the ultimate shop needs became

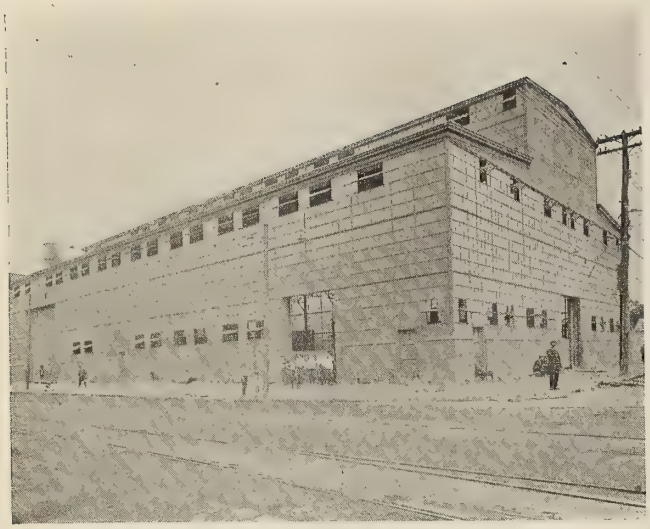


Fig. 2.—Exterior of Heavy Forge Shop



Fig. 3.—Woodworking Shop, Type of Concrete, Steel and Glass Building Constructed After the Fire of 1918

known permanent structures were commenced. In December, 1917, a disastrous fire destroyed nearly all the temporary structures, as well as part of the machine shop. This fire only served to hasten the completion of the new building plans, so that little time was actually lost in the production.

New Buildings

A modern concrete and glass building intended to accommodate the joiner and carpenter shops was practically finished at the time of the fire, so that these departments did not suffer any inconvenience. The existing machine shop was doubled in size and an addition made to the administration building; the warehouse capacity was doubled, a paint shop, pipe-covering shop, an electrical department and a power house, a copper and sheet metal shop, and a compressor plant were built. Adjacent to the carpenter shop a modern concrete building was put up to house a heavy forge plant.

As it exists today the main plant in Brooklyn covers 40 acres and employs about 6,000 men. An auxiliary yard, where sections for the Morse floating dry dock are built, is located not far from the main plant. By the summer of 1921, the third plant will be ready for production on Staten Island.

Organization

Facilities and equipment are at hand in the yard for carrying on practically any repair operation that may be required. As the dry docks are the base of operations for all the work in the plant they must be supplied by all the shops and equipment in the entire yard. An arrange-

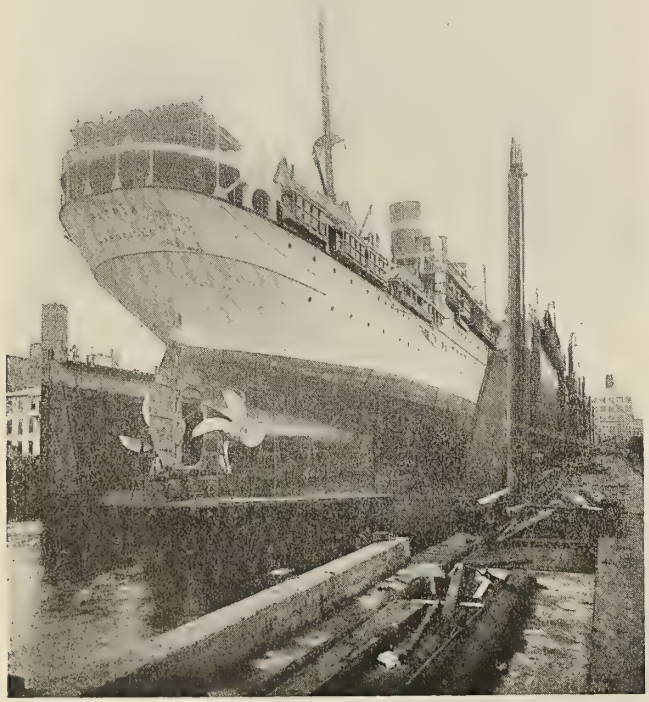


Fig.4.—S. S. Patria Lifted on Four Sections of 30,000-Ton Floating Dock in Record Time



Fig. 5.—The Yarmouth and Lake Fariston Lifted Simultaneously by Five Sections of 30,000-Ton Floating Dry Dock



Fig. 6.—View of Morse Yard During War Rush Period. Three Sections of New Dock in Use at Right, Other Dry Dock at Left



Fig. 7.—S. S. Chicago, of 11,127 Gross Tons, Raised on Four Sections of New Morse Dry Dock in 21 Minutes

ment of departments will serve to indicate the general organization that is maintained for this purpose:

Floating Dry Docks, two:
- No. 1, 3 sections, lifting capacity 15,000 tons.
- No. 2, 6 sections, lifting capacity 30,000 tons.

Department of Administration:
- Offices of company.
- Office organization.
- Purchasing department.
- Publicity, advertising, photographic, printing.
- Solicitors (in ship repair plants a section is maintained for soliciting business from ships needing repairs as they enter port).

Technical Section
- Drafting (hull and engine).
- Estimators.
- Surveyors.
- Inspectors.
- Superintendents of departments.

Traffic Department:
- Motor trucks and repair shops for maintaining equipments.
- Electric utility tractors.

Salvage Department.

Store Rooms:
- Brass.
- Exterior shop storage, yard storage space for plates, boiler tubes and the like.

Receiving and Shipping Division.
Machine Shop.
Blacksmith Shop.
Boiler Shop.
Plate Shop.
Heavy Marine Forge Shop.
Electrical Shop.
Sheet Metal Works.
Nickel Plating Department.
Copper Shop.

Woodworking Building:
- Carpenter shop.
- Sawmill and lumber yard.
- Brazing.
- Joiner shop.
- Pattern shop.

Pipe Covering Department.
Plumbing Department.
Pipe Fitting Force.

Rigging Loft:
- Ship riggers.
- Crane riggers.
- Splicers.

Paint Department:
- Hull painters.
- Interior painters and decorators.

Floating Equipment:
- Ocean and habor tugs.
- Launches.
- Steam lighters.
- Welding barges.
- Dredges and scows.
- Pile drivers.

Burning and Welding Division:
- Electrical welding equipment.
- Oxy-acetylene welding and cutting.
- Acetylene compressing plant.

Ship Repair Division.

Hull Department:
- Riveting gangs, (riveters, holders-on, passers and heaters).
- Ship fitters.
- Chippers and calkers.
- Drillers and reamers.
- Airmen.
- Bolters-up.

Outside Machinists:
- Work on the ships.

Inside Machinists:
- Shop work, lathes, drills, etc.

Auxiliary Yard:
- Dry dock construction, ways and equipment.

Dry Docks

One reason for the success of the Morse Company has been the dry dock equipment, which on recent completion of the sixth section of dock No. 2 became the largest sectional floating dry dock in the world. It will accommodate a ship 750 feet long and of 30,000 tons deadweight.

Each of the six sections of the dock is 100 feet by 300 feet, with a lifting capacity of 5,000 tons, and of a special design produced by the Morse Company from its past experience in dock construction and operation. Over a million square feet of timber and 210 tons of bolts were used in the construction of each section.

The usual centrifugal pump equipment is located low down in each pontoon, connected by pipe lines to the watertight compartments on each side of the section. Gate valves operate in the suction pipes from the tops of the towers. Flooding pipes are also operated by gate valves controlled from the tower tops. Dock trimming is accurately maintained by the careful manipulation of these valves. Capstans and motors are mounted on the towers for actuating the pumps and handling the ships while in dock.

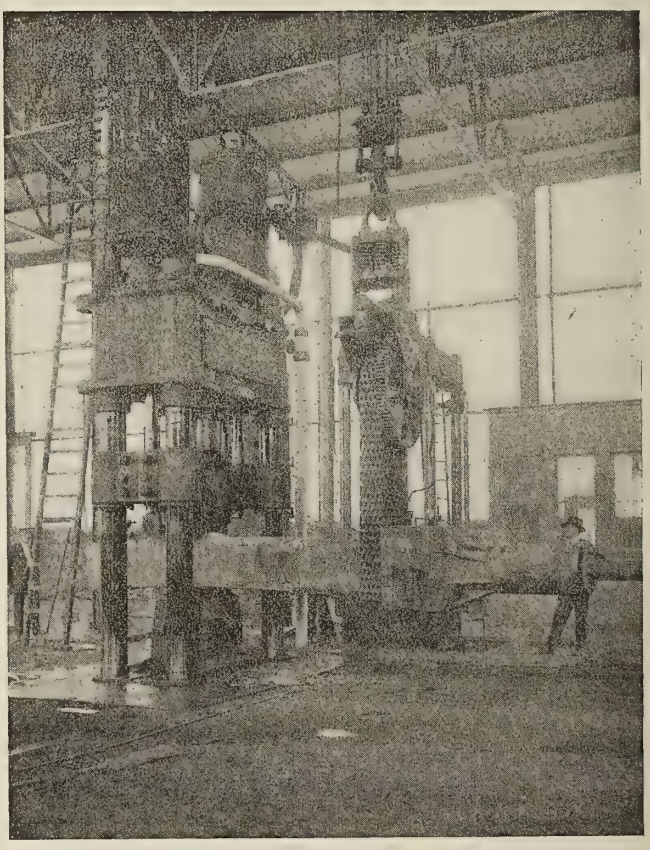


Fig. 8.—Hydraulic Press and Work Rotator in Action in Heavy Forge Shop

The sixth section, which was built in 64 working days, was launched September 26, and when put in operation early in November brought the dock up to its designed capacity of 30,000 tons.

Docking

In December, 1918, dock No. 2 became a productive factor in the yard, for the three sections then in commission were able to lift ships up to 15,000 tons net and 475 feet long. The *Black Arrow,* a Shipping Board vessel, was the first ship to be raised from the water in this dock. The speed of lift in this case was a foot a minute.

With the addition of later sections, the dock capacity has been increased. The French liner *Chicago,* 508 feet long, 57 feet 8 inches beam, 11,127 tons' deadweight, was lifted in 21 minutes. The French liner *Patria,* 485 feet 5 inches long, 56 feet beam, and of 12,000 tons, was docked for the first time on this side of the Atlantic in this dock. On November 8, when but two sections of dock No. 2 were in use, the steamships *Yarmouth* and



Fig. 9.—Work being Carried on in the Blacksmith Shop

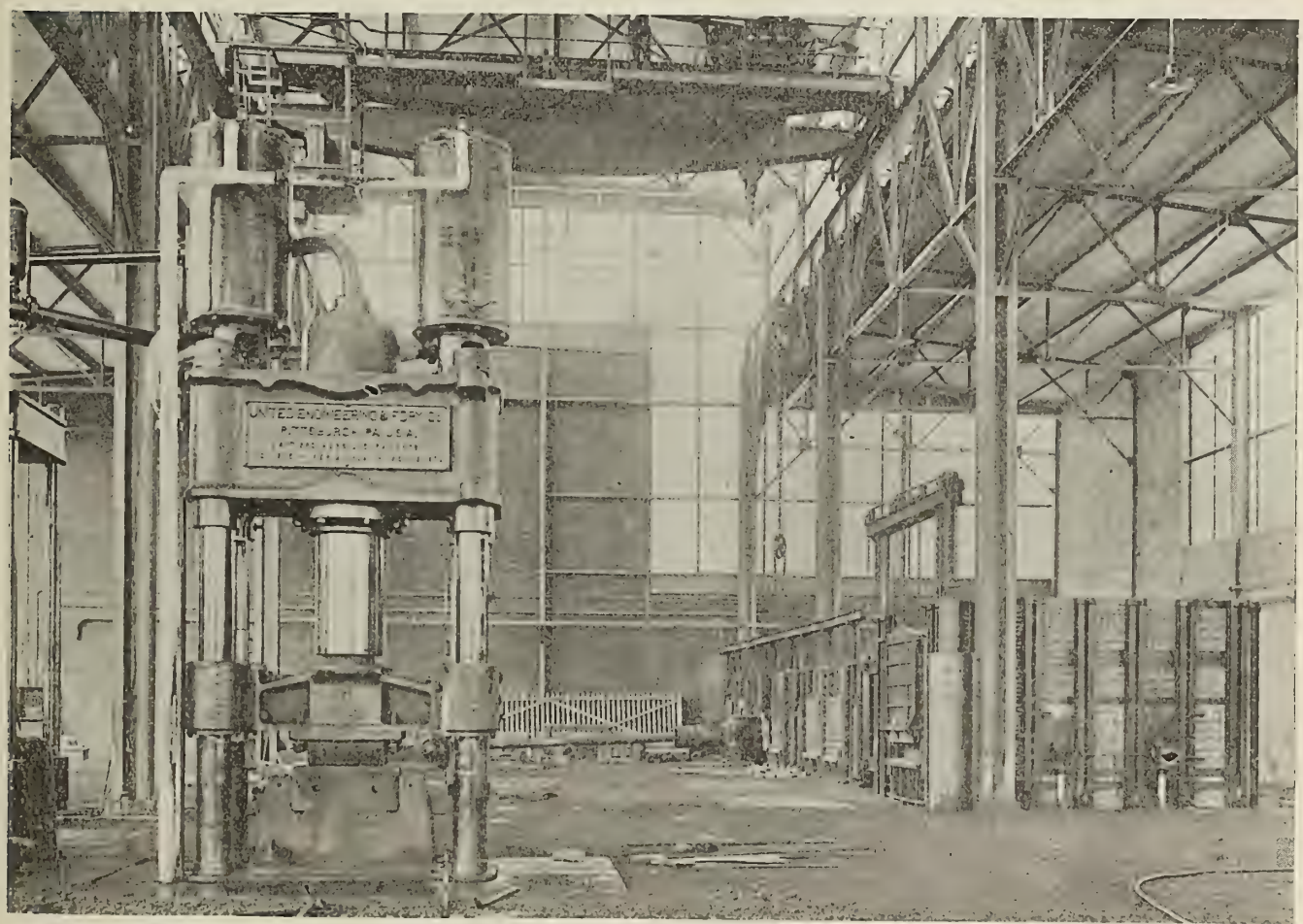


Fig. 10.—Furnace and Crane Equipment in Heavy Forge Shop Used to Supply Billets to Hydraulic Press and Hammers

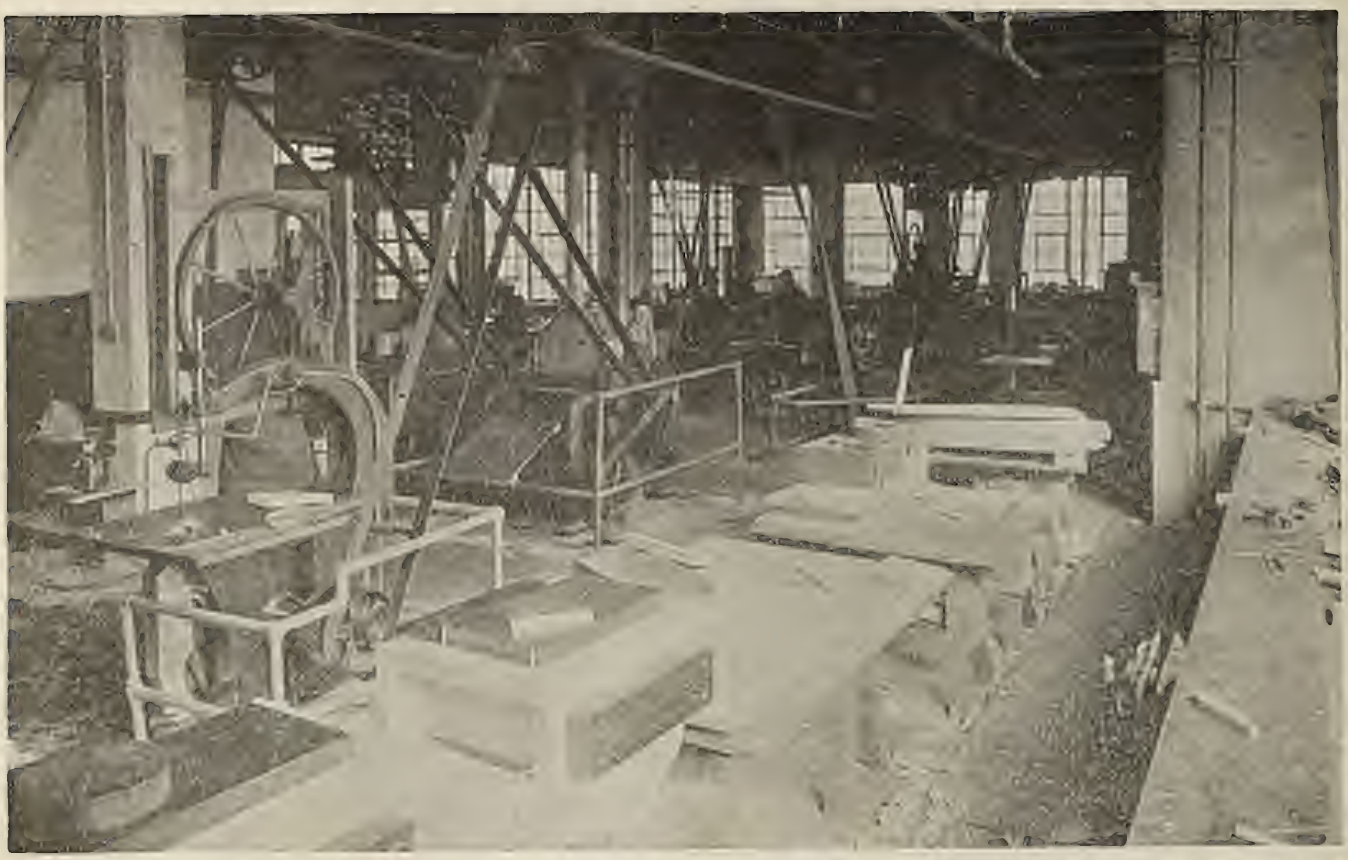


Fig. 11.—All Patterns Required by the Morse Company Are Made Up in This Shop and Supplied to Outside Firms for Pouring the Necessary Castings

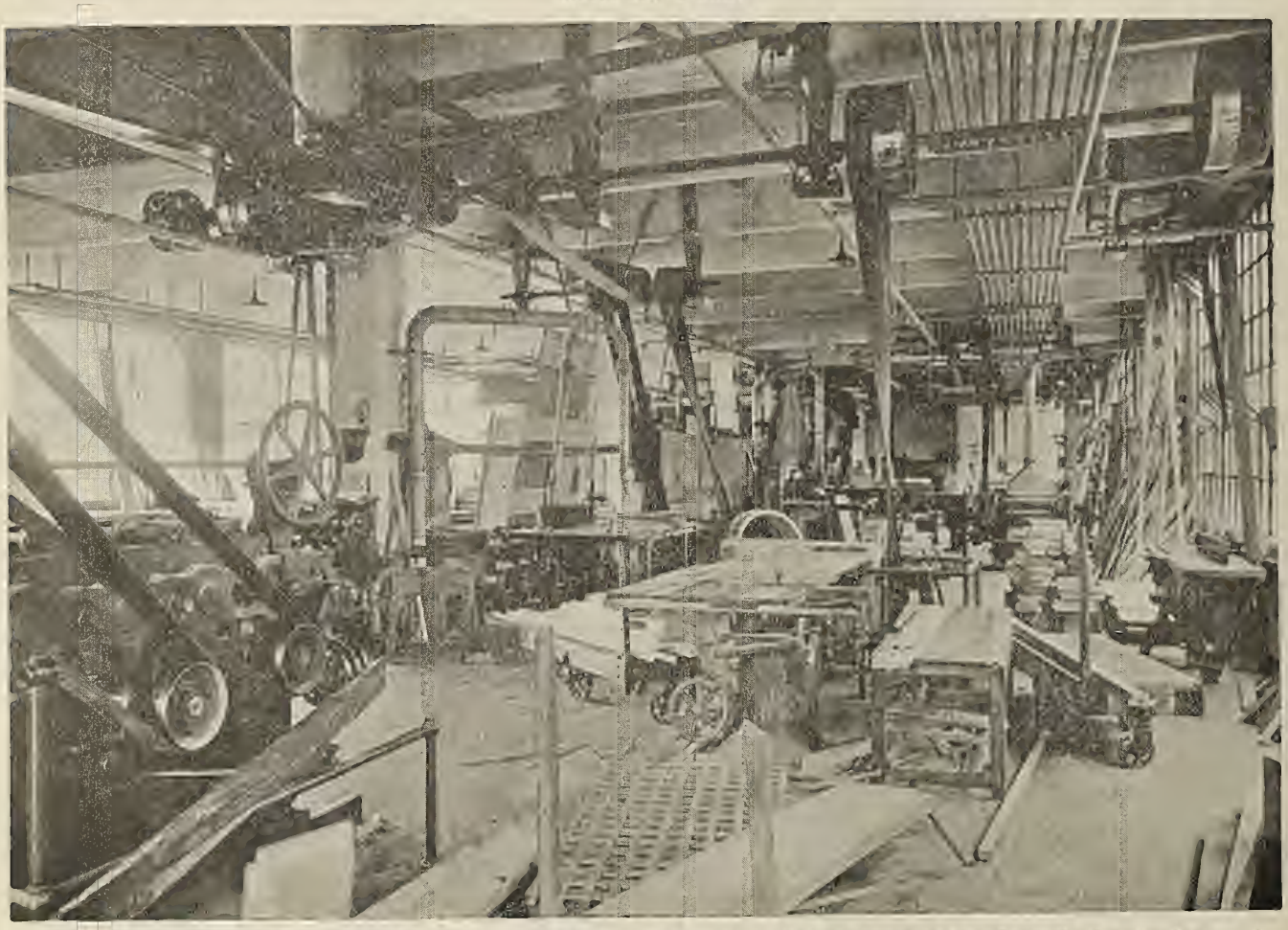


Fig. 12.—The Joiner Shop of a Ship Repair Plant is Particularly Important for It Is Necessary to do a Great Deal of Replacement Work and the Shop Equipment Must be Adequate to the Needs, as in this Case



Fig. 13.—General View of Plate Shop in Which a Clear Space Has Been Maintained Through the Center for Facilitating the Construction of Superstructures Complete

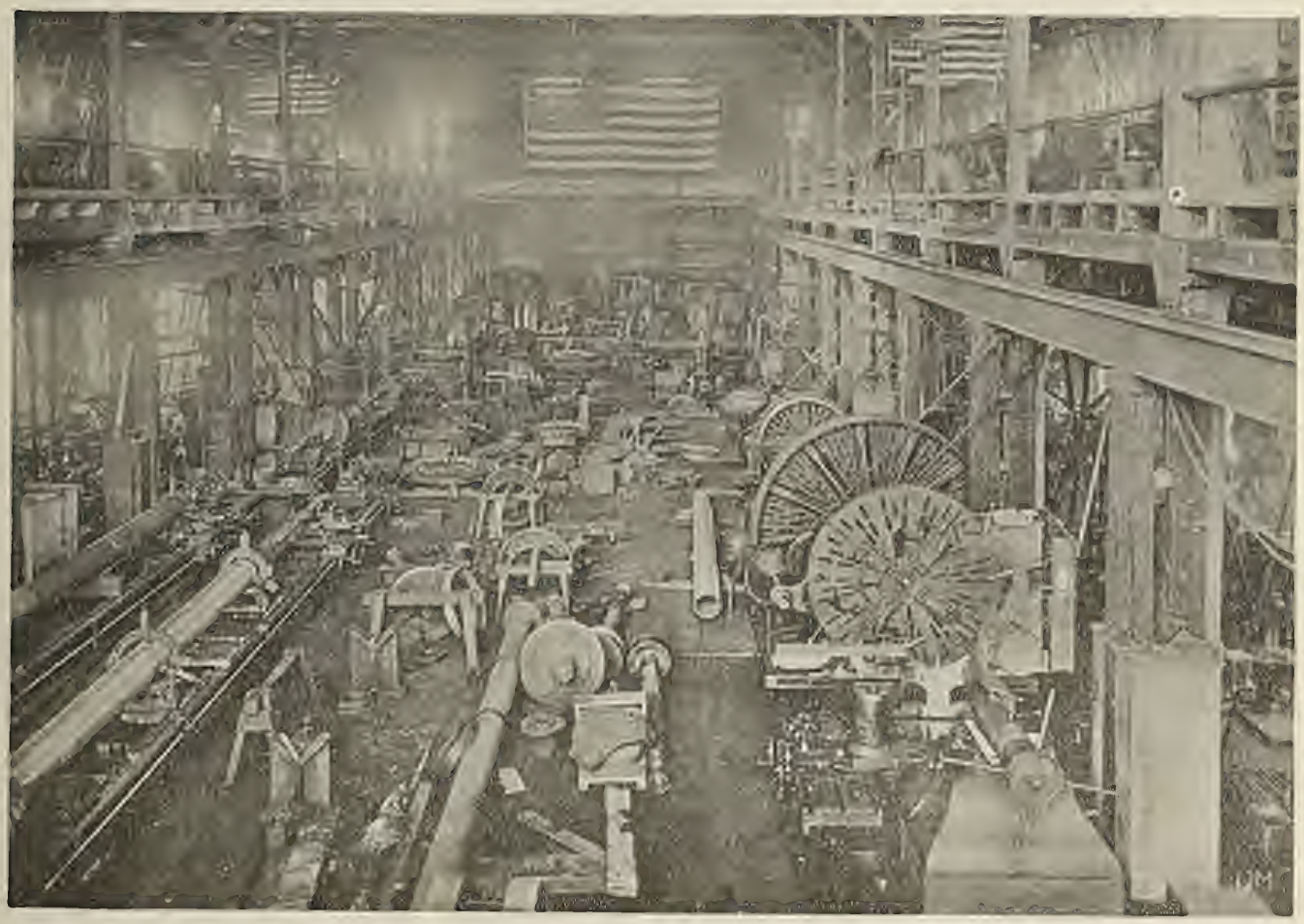


Fig. 14.—All of the Shop Work Required in the Construction of Engines or in Their Repair as Well as a Vast Amount of Other Machine Work Can be Carried on Without Aid From Other Plants

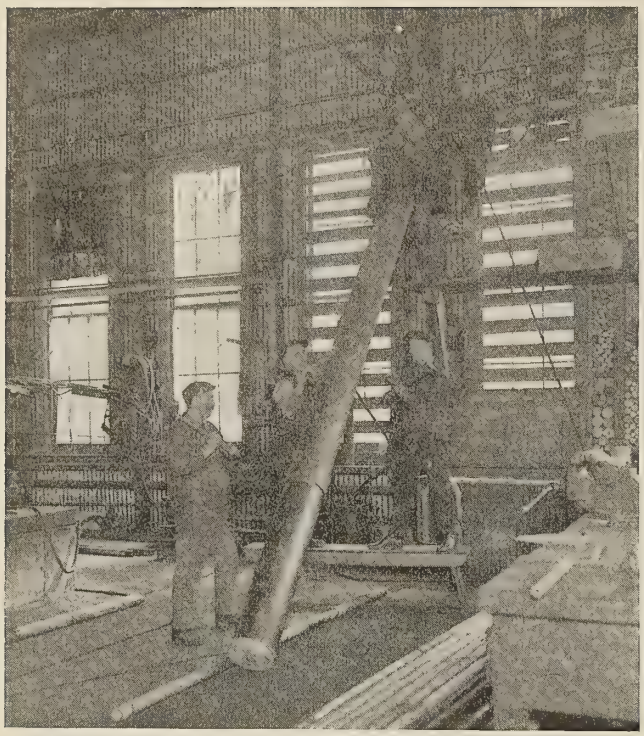


Fig. 15.—Filling a Large Pipe with Sand Before Bending

Lake Fariston were both docked, work being done to the *Lake Fariston* while the *Yarmouth* was being lifted.

Tugboat Fleet

The floating equipment includes lighters, dredges, scows, harbor and seagoing tugs and launches. The policy of maintaining company-owned tugboats has tended towards economical and rapid service by making the yard independent of the commercial tug. Delays in handling ships in and out of the docks have thus been eliminated. The tugboat fleet consists of three seagoing tugs, the largest and most recently constructed of which is the *E. P. Morse,* and three harbor tugs. The *E. P. Morse* is the only tug in the port of New York fitted for ice breaking. She has accommodations for a crew of 18 men. The second largest seagoing tug, the *Anson N. Bangs,* has the following details of construction:

Length overall, 101 feet.
Beam, molded, 23 feet.

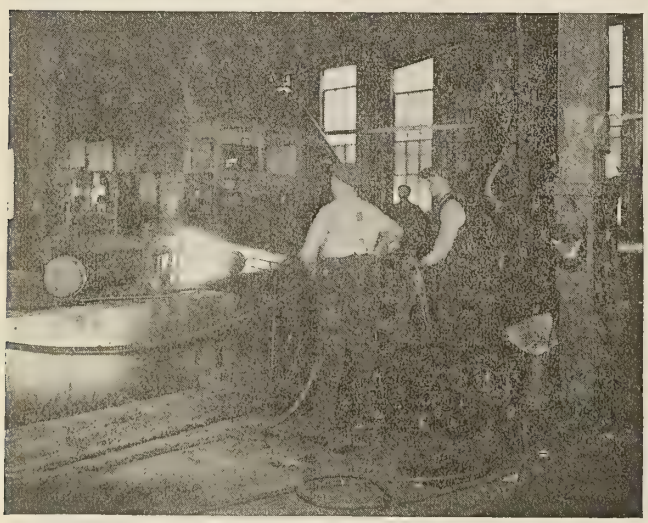


Fig. 16.—The Same Pipe in Process of Bending

Depth, molded, 22 feet 2 inches.
Draft, forward, 9 feet 6 inches.
Draft, aft, 13 feet.
Gross tonnage, 178 tons.
Net tonnage, 68 tons.
Speed, 12 knots.
Cruising radius, 960 miles at 10 knots.
Compound engines, 22 inches by 40 inches by 28-inch stroke.
One Scotch boiler, 15 feet diameter, 11 feet 9 inches long, with three furnaces.
One surface condenser.
Generator, 1 kilowatt.

The third seagoing tug is somewhat smaller than these two, but has made good performance records in towing. Two of the tugs recently made the run from Norfolk, Va., to New York, towing a 4,218-ton vessel, in 50 hours. At another time the Argentine transport *Pampa,* the rudder of which had been carried away in a storm, was towed from Newport News, Va., in 53 hours. The *Ansaldo III,* an Italian tank steamer, adrift and short of fuel, was towed into port stern first without difficulty in about three hours.

Five barges and lighters with three soliciting launches make up the remainder of the fleet. The barges are equipped as floating machine shops; the largest lighter has a 20-ton derrick, a Worthington air compressor of 250 cubic feet per minute capacity, and a deck loading capacity of 200 tons, but is without welding apparatus. The others vary but slightly in these details, but in each case have welding equipment. The welding outfits are of various types and will be described later, but combined there are two 2-men and three 3-men equipments. The total compressor capacity amounts to 1,160 cubic feet of air per minute.

Yard Equipment

Practically every detail of repair or construction work can be done in the yard without aid from outside plants. In the process of fabricating a structure, either new or one that is being repaired, the movement of the parts is from the head of the yards down to the docks, and return movements of material have to a great extent been eliminated.

Woodworking Shops

Just outside the yard proper are the woodworking shops, containing the carpenter, joiner and pattern-making departments. The equipment in all these departments is quite complete and includes several special devices which have been developed for quantity production in the woodworking trades. Besides the regular band, circular and swing saws, planers and lathes that are to be found in up-to-date woodworking shops, the equipment includes: A four-sided planer, two traveling dado heads, a 5-foot sanding machine, several hollow-ground mortising machines, and a number of others adapted for particular uses in the pattern and joiner shops.

Heavy Forge Plant

The heavy forge shop is equipped to handle all kinds of iron and steel forgings for marine and industrial purposes, but specializes in tail shafts, crank shafts, crank pins, connecting rods, eccentrics, stern frames, rudder stocks and the like. Forgings up to 50,000 pounds may be prepared to meet the needs of the yard, as well as those of other shipyards, machine tool manufacturers, machine shops and cement crusher mills.

The equipment includes: a 40,000-gallon fuel oil storage tank, two electric traveling cranes of 30 and 40 tons capacity, respectively; a 30-ton stiff-leg crane, a 25-ton derrick, a Claridge fan blower driven by a 50-horsepower motor, a steam air compressor and storage tank, two fuel oil pumps of 1 horsepower each. Hoisting and han-

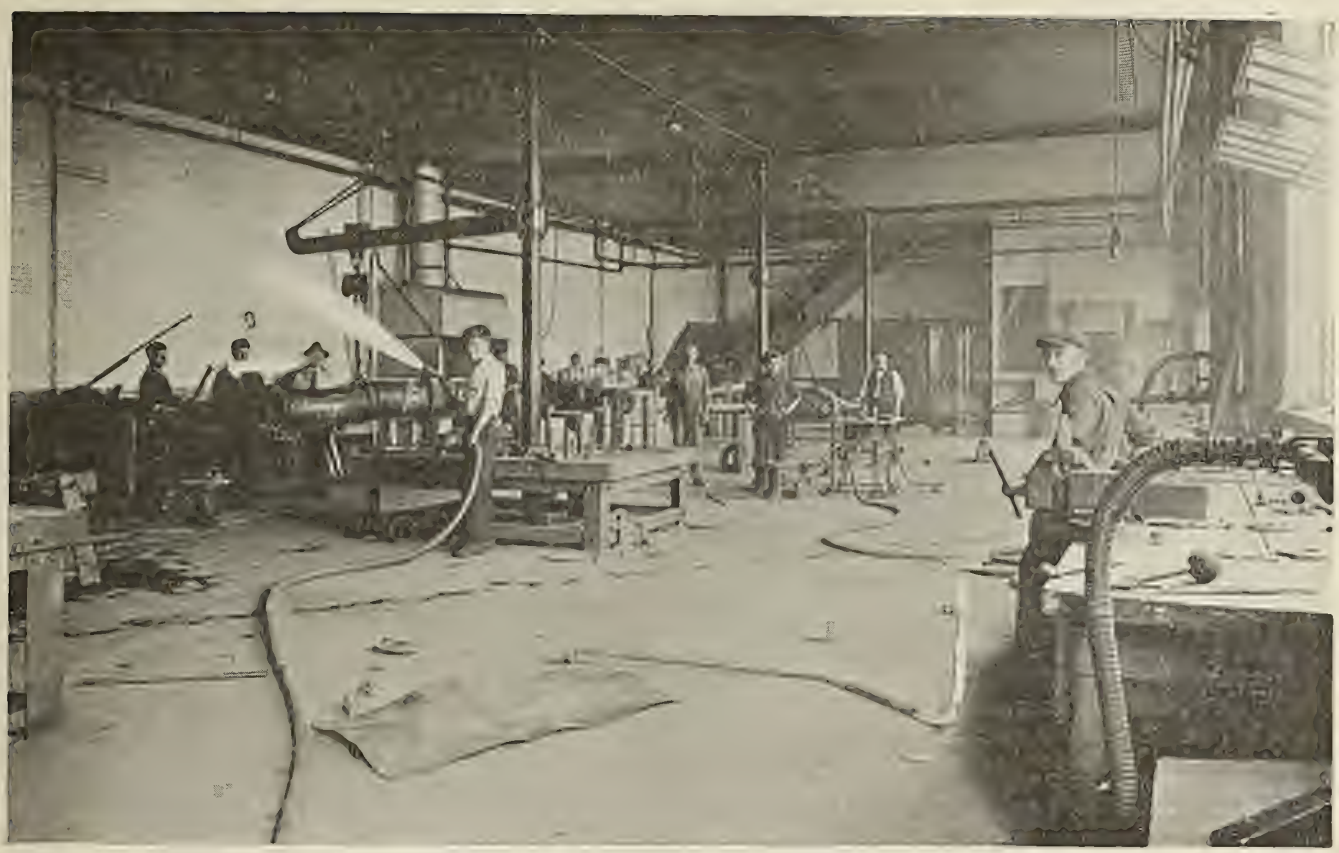


Fig. 17.—A Complete Copper Working Shop Is Maintained in the Yard



Fig. 18.—Sheet Metal Work Necessary in Building Tanks, Cowls and the Like is Produced in the Shop Fitted for this Work



Fig. 19.—Acetylene Generating Plant Built During the War in Order that a Constant Supply of Gas Might be Available in the Yard

dling equipment is supplemented by a 10-ton auxiliary hoist. Two 25-ton rotators may also be used for hoisting work, but are particularly adapted to rotate material that is being worked under the hammers. A 1,200-ton steam hydraulic press weighing 50 tons is capable of delivering a maximum pressure of 1,500 tons. The hammers include a 4,000-pound steam trip of the double frame type capable of handling work up to 5 tons, and several smaller machines. There are 10 furnaces, each having 26 oil burners used to keep metal supplied to the hammers and presses, as well as for annealing and heat treating such forgings as require these processes. Ingots up to 25 tons may be heated in the furnaces.

Welding Equipment

During the summer and winter of 1918, the acetylene supply in the yards for welding and cutting operations was anything but certain. As a result arrangements were made with the Davis Bournonville Company, Jersey City, N. J., to erect a special generator plant in the rear of the heavy forge building for supplying the needs of the shops. The little generating plant that resulted is very complete and is able to produce 13,000 cubic feet of gas per week. Generating and compressing processes are carried on in:

Two generators having a carbide capacity of 3,000 pounds each.
One gasometer, 100 cubic feet capacity.
One Frankoline purifier.
One compartment filled with limestone.
Two drier sections.
One compressor, having a capacity of 6 cubic feet per minute at a pressure of 250 pounds per square inch, operating at 72 revolutions per minute.
One five-horsepower Crocker Wheeler motor, 3-phase, 220 volts, 132 amperes, 750 revolutions per minute.

This system is capable of charging 12 tanks of three different sizes at a time. Steam heat is utilized to keep the temperature of the gas constant in winter during the charging process. About eight tons of carbide is stored in the supply vault.

Danger from explosions has been reduced to a minimum by fitting special ventilators in the roof to carry off any gas that might accumulate in the generating chamber. All electrical equipment is non-sparking, which also tends to increase the safety.

Acetylene welding equipment in the yard is divided between the shops and the docks. Five outfits are kept busy in the blacksmith shop, welding angle irons, frames, deck house fittings and the like. Five more work on castings all the time, while about a dozen are utilized for general work on the ships and eight or ten by the chippers and calkers.

Electrical outfits used to advantage on the barges previously mentioned include one Wilson 2-man unit on the *John Hallock.* The lighter *Panuco* is similarly equipped, but with a Lincoln type instead of the Wilson. The *Captain Roche* and *Captain Kirby* each have one 3-man Westinghouse set, while the latter has one 2-man Wilson in addition. All electrical welding apparatus in the yard operates at 300 amperes and 175 volts. Special units for use in various parts of the yard include four small outfits and two double Lincoln sets.

On the *Von Steuben,* a converted ex-German ship, 32 sheets in the main boilers were welded by one gang in 60 days, this time including the acceptance tests. A base for the turning gear on the *General Gorgas* was lined up and welded in 24 hours. Three rudder chocks were repaired on the battleship *Texas* in 5½ working days, by means of the oxy-acetylene torch. This repair saved the necessity of installing a new stern frame. Another special job on the tail shaft of the *Arizona* is being completed at this time. The shaft in question was forged one-inch smaller in diameter than required. Additional metal has been welded onto the shaft by means of the electric arc, so that the diameter after machining will be as originally designed.

Plate Shop

As in the case of the other shops in the yard, the plate shop is intended for the fabrication of repair parts rather than complete ship production. For this reason the machine equipment is of a slightly different character and

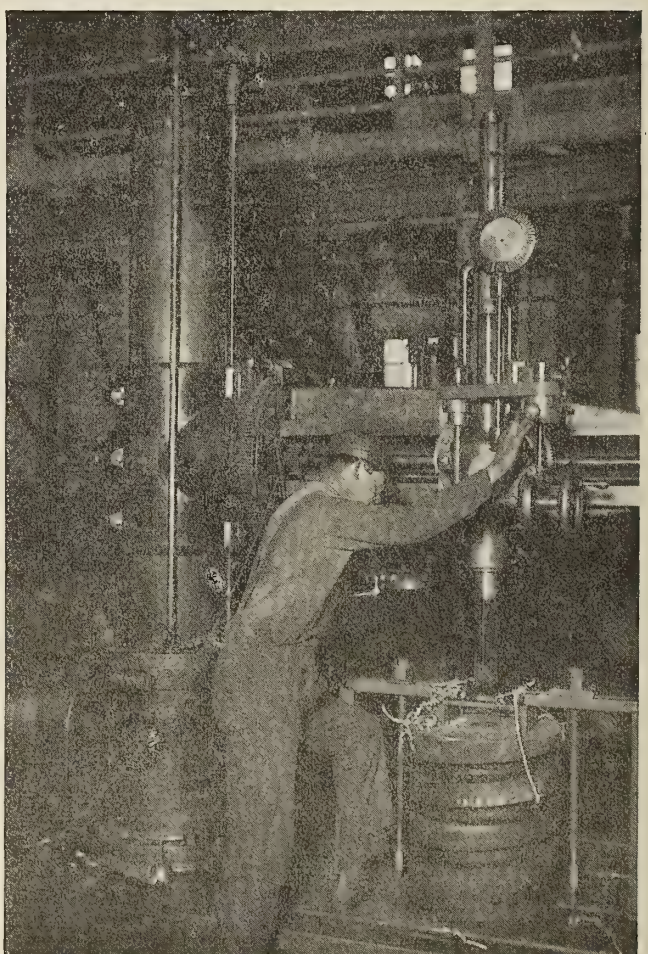


Fig. 20.—Machine Developed in the Morse Plant for Boring Square Holes

arranged in a different manner than is the practice in shipbuilding plate shops. The machine layout is such that the complete assembling of deck houses and superstructures may be carried on efficiently, as this sort of work is done to a great extent to eliminate the delays attending their fitting on the ship. The ordinary production required is readily handled in this shop.

Blacksmith and Boiler Shops

The boiler making department and the blacksmith shop are housed in a glass and steel building, 152 feet by 81 feet, and are equipped to handle any work that may be required of them.

Five 12-inch Potter McDougall steam hammers and one 9-inch steam hammer of the same make constitute the main equipment of the blacksmith shop. A pair of alligator shears made by the Canton Foundry and Machine Company, driven by a 15-horsepower General Electric motor, accommodates round and square metal up to 3½ inches. Forced draft for 30 fires in the shop is supplied by a Buffalo Cupola and Forge blower, driven by a 10-horsepower motor, and an auxiliary blower of the Garden City Fan Company, driven by a 5-horsepower Watson motor.

On the U. S. S. *Von Steuben,* which was converted into a troopship in the Morse yards, twenty-eight back connection tube heads were cut out, renewed and installed, new fireroom flooring was fitted and the boilers generally overhauled. During most of the period required for this repair (about 3½ months) seventy men were at work in the day time and about fifty in the night shift. This repair job was probably the most extensive of any handled by the boiler department during the war.

One of the most rapid repair jobs done by the boiler crew was on the supply boat *Orian.* Fifteen men of the boiler department working on day and night shifts retubed one double-ended boiler, did all of the calking necessary and put in new fireroom foundations and flooring in five days.

Machine Shop

When the fire of 1917 gutted the existing machine shop, a structure of double the previous size was built. This building, of steel and glass construction, is 210 feet 2 inches by 81 feet, and contains equipment for handling both regular and special machine requirements.

Power for the yard is supplied by the Edison Company through 6,600-volt feeders to three sub-stations, where the current is converted to 440, 220 and 110 volts, 3 phase, 25 cycles, and distributed to all parts of the yard.

Compressor Plant

The compressor plant is equipped with two electrically driven Ingersoll-Rand compressors, each delivering 3,750 cubic feet of air per minute at 100 pounds per square inch pressure. They are driven by two 600-horsepower Westinghouse synchronous motors operating at 6,300 volts, each equipped with a Westinghouse starting compensator and an oil circuit breaker. Low pressure compressor cylinders have a 32-inch bore and 24-inch stroke; high-pressure cylinders 20¼-inch bore and 24-inch stroke. Two 10-kilowatt, 125-volt, 80-ampere, 950-revolution per minute, belt-driven exciters, two Westinghouse transformers and a Gould well-pump for cooling purposes, having a capacity of 75 gallons per minute and driven by a 10-horsepower Westinghouse motor, complete the compressor room equipment. An auxiliary compressor of the Ingersoll-Rand steam-driven type, delivering 1,000 cubic feet of air per minute, is located in the boiler house, and an additional electric compressor, also delivering 1,000 cubic feet per minute, is in the process of installation.

The boiler shop is equipped with four boilers, two of the upright fire-tube high-pressure type, generating steam at 150 pounds per square inch, and two McNall watertube boilers generating steam at 100 pounds pressure. The heavy forge plant is supplied by an independent boiler department equipped with two 300-horsepower McNall watertube boilers.

Salvage Department

Until recently shipyards have not considered the salvage department as a necessity in their operations. During the war, however, its great value was recognized and practically every yard of size had such a section. Particularly in a repair plant is there a vast amount of usable material which is ordinarily discarded while a ship is being refitted. Besides the rivets, plates, beams and steel sections dismantled, there are oftentimes engine parts, boilers, galley equipment, stewards' supplies and vast quantities of other material that have to be replaced or eliminated before the ship is considered to be in condition for service.

In the Morse yard, the salvage work is carried on by a crew of about twenty men, aided by motor trucks and electric tractors. Each department and shop has a bin into which all waste material is thrown to be collected and inspected later. In this way quantities of bolts, rivets, angle irons, ship's ladders and the like are put into shape for use again, while all manner of supplies and junk are sold to outside firms.

Special Repair Jobs

Much of the early war work was in converting German ships into troopships, all of which had to be done very quickly, so that the troop movements would not be delayed or interrupted. The *Kaiserin Augusta Victoria* and the *Mobile* were turned out at the Morse plant and the Hoboken division in eleven and twelve days, respectively, ready for service. The old army transport *Henderson* had the sole plates and engine foundations in general repaired in 39 days. To facilitate this work the engine had to be lifted four feet from the base and braced in this position until the new foundations were installed. On another occasion the *Imperator* was completely painted in 12 days.

One of the best records accomplished in the Morse plant was the refitting of the *George Washington* in 76 hours. Just before her voyage with the President's party, 49 staterooms were refitted and redecorated, destroyed furniture replaced and old furniture rebuilt. Besides work on the staterooms it was necessary to equip sixteen bathrooms. Hot water piping had to be installed, as well as the existing salt water lines eliminated. A conference hall was built, two smoking rooms aft were entirely remodeled, a ladies' lounge fitted and all the main corridors redecorated.

In keeping with the United States Shipping Board's policy of expansion, the U. S. S. *Huron,* formerly the *Frederick der Grosse* of German naval command, has come to the Morse yards to be fitted as the finest U. S. government passenger and merchantman. The *Huron* contract involves a large sum of money and a great volume of work and is considered by shipping men in general to be the largest ship repair job ever undertaken in America.

Refitting the Huron

Prominent among the operations the *Huron* will undergo is the installation of a fuel oil burning system of 24 furnace fronts, complete with burners, to operate under natural draft, and three oil heaters any two of which are to be capable of operating the entire plant. Another installation job of big proportions is that of a

Sperry gyro stabilizer with a foundation for it that will take a maximum thrust of 470,000 pounds.

There will be provided also suitable seatings and fastenings for the following auxiliary apparatus to be located in No. 6 hold adjacent to the gyroscope: One rotary converter, a switchboard, two steam oil pumps, one strainer, one oil tank, one set of resistance grids, one vacuum pump, one control gyro, one cooler, and one steam-driven electric generator. The necessary steam and exhaust piping to pumps and generator, and salt water supply, and a drain to cooler, will also be furnished.

A gymnasium, located abaft the engine room hatch, is to be constructed of wood and will have windows of opaque glass with Louvre shutters. A new house for the wireless room will be erected, as will a new house to contain the first and second-class hospitals. The entire after end of the deckhouse is to be completely rearranged, the space in the center to be used as a library and reading room. These will be finished in hardwood wainscoting and pine paneling.

The second-class smoking room is to be fitted with paneled oak settees with spring seats and upholstered backs and the deck covering will be rubber or cork tile. A printing shop will be erected on the port side. The passenger rooms in general are to be fitted with a view to the utmost cleanliness, airiness and sanitation. Forty new outside hardwood doors to staterooms are to be fitted in a steel house, and a fire indicating and extinguishing system, to be used in connection with a smothering system, is to be installed.

While the *Huron* is considerably smaller than the *Leviathan,* it is much larger than the ordinary run of Shipping Board vessels. It is 545 feet long and of 10,800 gross tons. Interned in New York harbor at the outbreak of the European war, the *Huron* was taken over by the United States upon our entry into the conflict. Like other German ships, she was more or less damaged by her German commanders and crew, but American ingenuity and initiative soon got her into commission and she gave excellent service. Her usual runs as a troopship were between Norfolk and St. Nazaire, France. She carried on each trip (more than a dozen in number, with and without convoy) 4,500 officers and soldiers beside a ship's crew of 500.

Her career as a troopship was not without event. One night when about 200 miles off St. Nazaire she struck something, presumably a German submarine. No damage was sustained by the *Huron,* but members of her crew felt that there was one less enemy submarine at the close of the incident, for when a ship the size of the *Huron,* heavily laden and traveling at 15 knots, hits anything, there is small chance for the rammed craft to survive.

Employees' Association

Practically all of the employees of the Morse Company belong to an association which in addition to its promotion of social intercourse has the fundamental object of looking after the welfare of the men while at their work in the shops. The association was organized about three years ago and is now perhaps as far advanced as any similar representative body in the country. The officers of the association are nominated and elected each year by popular ballot and at election time enthusiastic campaigns are carried on.

A sanitation committee, an accident prevention committee, a fire prevention committee and various other committees look after the welfare of the men. In addition to a president, vice-president, secretary and treasurer, there is a board of directors represented by one man from each department in the yard and also a conference board represented by two men from each department. In case any question arises concerning wages, hours of labor and other matters which require adjustment, the very simple expedient of placing the matter before the conference board and the company has proved successful. The company has an industrial director, who upon receiving any complaint from the men immediately seeks to straighten the matter out. If he is unsuccessful, the complaint is taken before a joint meeting of the conference members, representing three members for the men and three representing the company. In every case thus far the conference board has worked successfully.

In connection with the association the company publishes a monthly magazine, which has the distinction of being the first shipyard magazine in the country. A complete printing and photographic division is carried on in the plant so that even in this respect the yard is independent of outside help.

Increasing Stoke-Hole Efficiency

BY A. POHLMAN

AT this particular time every thinking marine engineer can plainly see the writing on the wall. He realizes as his brother engineer in the stationary field that the old rule of thumb methods of operation are no longer applicable to modern power plant operation either ashore or afloat. Indications today point to the marine engineer as one of the factors by which the powers that be will decide whether or not the stars and stripes will maintain their rightful place on the seas.

It is an established fact that the major cost of power is not labor, maintenance, supplies, interest, etc., but fuel. It was a common occurrance not long ago to find on investigation that fuel constituted eighty percent of the entire cost of operating. It is therefore apparent that the place to start to effect a reduction is the coal pile, not the pay roll.

An engineer would not attempt to guess at engine performances; he would use his indicator. Why not apply the same method to the boiler plant? Indicate your boiler furnace. It's simple, and one then knows absolutely—no guesswork. A furnace is nothing but a large carburetor. Get the right mixture and economy follows as a natural result.

The orsat or flue-gas analyzer is the indicator for furnace use. A half hour of practice combined with a little horse-sense will enable any engineer to use this instrument well enough to obtain very satisfactory results.

A sample of flue gas is taken at the point where the gases leave the heating surface of the boiler. This sample is then analyzed by means of the analyzer and the contents of CO_2, O and CO, respectively, are noted.

At the same time the draft and the thickness of fire are also noted.

From the above factors a practical fixed thickness of firebed and speed of blower or damper opening for that particular fuel are determined. This applies to either solid or liquid fuel.

This article is not intended for those who are familiar with flue-gas analysis but for those who are not versed in the subject. Incidentally, the writer would say that it is not even necessary that the operator know what CO_2 or CO is. While every engineer should know the meaning of these various symbols and something of the theory of combustion, anyone who can read a thermometer scale can use a flue-gas analyzer successfully.

The practical use of the analyzer will be explained in a later article.

Merchant Marine Hearings in Washington

Congress Still Taking Evidence—Favorable Report on Greene Bill the First Step Towards a Definite Marine Policy

By WALDON FAWCETT

BY means of public hearings in committee and through the medium of a voluminous correspondence, the Congress of the United States continues to acquire information on all phases of the subject of the American merchant marine. It became evident, however, early in the autumn that the legislation in encouragement of creation and maintenance of an American merchant marine and the fostering of an American shipbuilding industry, of which all this investigative work is the prelude, cannot materialize at the first special session of the 66th Congress. Authorization of a Governmental policy with respect to the merchant marine and allied activities waits upon the regular session of Congress that will convene in December. Meanwhile the hearings continue, and if any interest in the marine field remains unheard in this sounding of the sentiment of the industry, it will not be for lack of opportunity.

Although there lags somewhat the general legislation that will determine the attitude of the United States Government toward the merchant marine, it is worthy of note that Congress is making some progress in the direction of the legislation that will prescribe the nature and extent of Federal supervision and regulation of the railroads of the country after the rail lines have been returned to private management. It has come to be realized latterly that not only will the future of railroad operating policy have a broad if indirect influence, via export movements, upon the American merchant marine, but that there is, in the case of the coastwise lines, an intimate connection between the two classes of carriers. Accordingly, the outcome of the railroad legislation may, with advantage, be scrutinized for its effect upon coastwise shipping and shipbuilding.

While Congress continues, for the time being, in the attitude of listening to the evidence rather than attempting a verdict on the merchant marine issue, it is interesting to note the first appearance, from an authoritative source, of a bill designed to meet the present situation. Congressman Greene of Massachusetts introduced in October a bill, designated officially as H. R. 9823, which has as its object the repeal of certain existing legislation connected with the upbuilding of the American merchant marine and providing for the disposition, regulation and use of the property built or acquired by the United States under the emergency shipping fund provisions. This bill is worthy of more than passing notice owing to the circumstance that its author is chairman of the committee on the merchant marine and fisheries of the House of Representatives. To be sure, the measure has not been "reported out" or recommended for passage by this committee but, representing the individual views of the head of this committee, significance attaches to this proposal as constituting the first concrete program for the solutions of the problems at hand.

The first definite expression of the lower branch of the national legislature on the subject of a merchant marine policy came in November on the eve of the adjournment of the first or special session of the 66th Congress when the House committee on merchant marine and fisheries brought in a favorable report on the Greene Bill. This measure provides that all merchant ships and other property acquired by the President incident to the war-time emergency shall be transferred to the Shipping Board for management, operation, lease or sale. The Board is authorized to sell to citizens of the United States or aliens, other than enemy aliens, all vessels on hand, due provision being made for deferred payments. Vessels not sold by the Board shall be managed and operated by it or chartered or leased on a time basis or on terms of division of gross and net operating income. Under the stipulations of Section 12 of this Act the Shipping Board is instructed, as far as is consistent with the best interests of the United States, to discontinue the building of any ships and not to enter into any new contracts. The investments of the United States in the "various enterprises," including houses at shipbuilding plants, would be withdrawn as soon as possible.

The Greene Bill

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Congressmen who have been conducting the inquiry into the operations of the United States Shipping Board have disclosed an especial curiosity with respect to defects that developed in American-built vessels, supposedly incident to the necessities of war-time construction. Robert L. Hague who was in the construction and repair department of the Shipping Board from the outset of operations was called upon to particularize on this score. Discussing the effort to reconcile ship design and construction to the necessities of commercial operation, Mr. Hague said:

Defects in American-Built Ships

"The design section of this department was mainly started to correct defects that all the people who operated vessels reported to us, and we in turn took them up and corrected them with Philadelphia, and later on, as we noticed how some of these vessels were working out in operation, we could design for future needs. We felt

that in normal conditions Americans could operate in competition with foreign nations.

"There was a lot of difficulty regarding the workmanship in the actual construction of the ships. The trouble with the steel vessels mainly was due to the fact that we had so many vessels riveted and we did not have the riveters in the country to drive good rivets successfully; so the trouble with our steel vessels has been poor riveting, not due to any neglect but simply due to the fact that we did not have the riveters in the country and we had to build the vessels. With the wooden vessels the trouble has been poor calking, green lumber, unskilled workmen. Then, due to the fact that the hulls were being fabricated so rapidly, it was necessary to put in any machinery we could get and we put in such things as new turbines with reduction gearing. That has been one of our big figures in operation, the poor performance of these turbine reduction gears. That is why our repairs are running so high. We have, probably, 110 vessels in which defective turbine gearing will have to be replaced with new, successfully operating gearing."

Turning to the discussion of another angle of current operations in connection with the management of the fleet, this executive pointed out: "Repairs are the most troublesome part of our department. Formerly repairs were conducted on the cost-plus system. We abolished this and tried to put repairs on the same basis and handle them in just the same way as the big competing steamship companies would handle repairs. So far as possible, specifications are prepared and competitive bidding is secured, bearing in mind two things,—price and time.

Cost of Repairs

"Time is the essence of the contract and we so declare it and, in addition to competitive bids we make the man who is putting in a price state the number of calendar days he will do the job in, and we time pretty closely to that. We think that a ship is worth $1 per registered ton per day,—$1 per net registered ton for steel vessels and 50 cents per day for wooden vessels—and we insist upon liquidated damages for delay on that base price. I might say that 95 percent of the bidders realize that this is a way to protect them against their competitors, although they think the price is too high.

Mr. Hague went on to explain that in actual practice the full demurrage is insisted upon only in the case of contracts over $50,000. In the case of relatively small jobs it was found that enforcement of the terms would work injustice and also operated for the inflation of bids in order that bidders might play safe; consequently, for repairs of $25,000 and under there is an average for each day over the specified time (unless there is some reasonable excuse) of 33⅓ cents per net registered ton on steel vessels and half that on wooden vessels, while on jobs from $25,000 to $50,000 the figure is 66⅔ cents per net registered ton on steel and half that for wooden vessels. It was also explained that there are some occasions when it is impossible to get competitive bids and that there is a certain proportion of "voyage repairs"—jobs under $15,000—which are contracted for at the commercial rates of the shipyards, on a time-and-material basis. This last class of repair work has constituted, in the case of the Shipping Board, 10 percent of the total.

During the past few weeks the Congressional committee has pursued further the investigation into the marine insurance situation already referred to in these columns. The committee, or rather the subcommittee that has undertaken this particular responsibility, insists that it is not the intention to investigate marine insurance with any harmful ideas but to see if something can not be done to keep marine insurance, insofar as possible, in this country and to ascertain what conditions, if any, prevail to deter American fire insurance companies and other companies from going into the business. Along this line and with the idea of securing basic information, the subcommittee has sent out a number of questionnaires. The responses have been very satisfactory. Some of the information embodied in the replies may ultimately be made public but various contributors have asked that certain portions of their testimony shall be treated as confidential and this will be done. Congressman Edmonds, who is active in this investigation, recently remarked: "No one need fear that we are trying to make any destructive legislation. We are trying to make constructive legislation and trying to benefit these men who have and will and can build up the American merchant marine insurance."

Marine Insurance

Executives of various insurance companies have stated at Washington that if the grip which foreign companies hold on American marine insurance is to be broken it will be necessary to encourage a spirit of patriotism such as is claimed to exist in Great Britain. The Congressional investigators bemoan especially the tendency of American companies to cater primarily to cargo insurance and to neglect hull insurance, with the consequence that at least 50 percent of all American hull insurance is, according to the most reliable estimates, exported. More to the point, the American companies that have heretofore gone in for hull insurance have notified the Congressmen that, far from seeking to expand along this line, they are now making every effort to curtail this class of business on account of the competition with the foreign insurance market, which escapes all Government and State taxes.

The situation with respect to hull insurance is practically duplicated in the field of builders' risk insurance. Aside from the consideration of taxes, above mentioned, it also develops that a very large proportion of American builders' risk insurance is going to companies located in foreign countries because such companies may assume hazards which are forbidden to American companies by the laws of the various States in this country.

Disclaimer to the shipping and shipbuilding interests of any intention to enact embarrassing or oppressive legislation has likewise been made by the members of the merchant marine committee in connection with the consideration of a bill (H. R. 8422) dealing with the recording of mortgages on vessels and providing that maritime liens upon vessels for necessaries shall be subordinate to the liens of mortgages. There is a feeling among many shipbuilders, repairers, supply men, etc., that this bill presents a serious menace to their interests. Congressmen who favor the measure contend that the element of danger has been exaggerated. They have undertaken to point out to shipbuilding and repair interests that if their respective industries are to prosper means must be found to render safe and attractive the investment of funds in ships. It is pointed out that as matters now stand the trust companies of the country will not invest in bonds secured by ships; neither will such investment be made in the case of trust funds. The pending bill, which was introduced at the request of the United States Shipping Board, is supposed to remedy the situation reputed to exist as to the security of investments.

Protection for Ship Securities Sought

As explained to the committee by Ira A. Campbell, former admiralty counsel of the Shipping Board, who prepared the bill, it was drawn in the interest of two things:

first, to better safeguard the Government's interest in the sale of its ships with deferred payments for the purchase price, and secondly, in the hope that the financial investors or the banking interests of the country will be willing to invest their money more freely in ship securities. The contention is that investment in shipping is now discouraged and curtailed by the circumstance that liens arising out of repairs, collisions, salvages, seamen's wages and cargo damage all come ahead of the mortgagee. The bill or at least some of its features have been opposed in discussions at Washington by J. B. Certer, representing the Skinner & Eddy Corporation of Seattle and J. E. Barnes, representing the Todd Shipyards Corporation, the J. F. Duthie Corporation and the Ames Company. The principles of the bill have been favored by R. G. Bickford of the Newport News Shipbuilding and Dry Dock Company, Malcolm D. Webster, representing the New York Shipbuilding Corporation, and others.

Of parallel interest to the bill above mentioned is another (H. R. 7124), which authorizes suits against the United States in Admiralty and which is now under consideration by the committee on the judiciary of the House of Representatives. The legislative innovation which the enactment of this measure would accomplish has been brought about in large part by the construction programme of the Shipping Board. It would allow suit to be brought against any Government ship,—of the merchant fleet, the United States Navy, the United States Army, etc., etc.

In the Congressional inquiry into the operations of the Shipping Board it was disclosed that the principal difficulties encountered in the actual construction of ships during the war were due to the lack of skilled and experienced workmen. In the case of steel ships, the chief trouble was poor riveting—not because of neglect, but because there were not enough skilled ship riveters in the country to do the enormous amount of work required. In the case of wooden vessels the trouble came from poor calking, green lumber and unskilled workmen. After the ships were built the chief cause of trouble in operation was found to be in defective turbine reduction gears. At one time the Shipping Board had no less than 110 vessels in which it was necessary to replace defective turbine reduction gears.

House Committee Reports Favorably on the Greene Bill

In November, on the eve, as it were, of the adjournment of the first or special session of the 66th Congress, the committee on merchant marine and fisheries of the House of Representatives brought in a favorable report on the bill of Congressman Greene of Massachusetts referred to above, which provides for the promotion and maintenance of the American merchant marine. This measure thus became the accepted and approved expression of the lower branch of the national legislature on the subject of a merchant marine policy and whereas it was apparent that the Senate could not give expression to its views on the same general subject until December or later, the leaders in the House took the attitude that this body at least had done its duty in authorizing a definite programme with respect to the American merchant marine and the shipbuilding industry.

According to the report which accompanied the Greene bill when the merchant marine committee recommended its passage, that body found that in order to establish regularity in the future conduct of the numerous different shipping activities, operated either by order of the President through emergency legislation or by the original shipping act, it is essential that all of these operations be concentrated under one authority. This explains why the committee programme embodied both the repeal of existing legislation rendered unnecessary by the ending of the war and new legislation for future operation.

The merchant marine committee has defended vigorously the policy whereby the Shipping Board is instructed to sell available merchant tonnage, taking into consideration in the sale price the prevailing market prices for vessels of a like character, but disregarding the war cost of the vessels involved. It is admitted that under certain circumstances this will undoubtedly cause considerable loss to the Government, but it is contended that this is to be condoned in view of the fact that with the present building programme of the leading maritime nations of the world there must come a time before long when all the tonnage necessary for the carrying of the world's trade will be supplied. The committee foresees that when that time arrives shipping property will inevitably be depreciated to a level considerably lower than the war cost to the Government.

Sale of Surplus Ships

Figures have been compiled by the Congressional authority in support of its authorization for the sale of surplus ships at open market prices. Based upon the showing of Lloyd's Register as of date of July 1, 1919, it was computed that 8,000,000 tons of ocean-going vessels were under construction upon the ways of the different nations. This added to an existing ocean-going tonnage of 49,000,000 tons gave a total of 58,000,000 tons available for operation at a period within the next few months, as compared with less than 50,000,000 tons available in 1914. The committee likewise reached the conclusion that the disturbed trade conditions now existing would further tend to cause shipping tonnage to equal the demand for it.

It has been pointed out that the only vessels to be disposed of under its plan to foreign interests are the smaller vessels which would not prove desirable in ordinary commercial work, but which are well adapted to certain classes of coastwise trade. A limitation of five years placed upon the operation activities of the Shipping Board in the conduct of the Government-owned fleet is deemed to allow the Board ample opportunity to establish lines and to handle any tonnage that may be offered.

In granting to the Shipping Board the privilege of maintaining its own insurance fund covering the tonnage under its control the merchant marine committee took occasion to indicate pointedly that there was no compulsion in this "if it is found advantageous to utilize this insurance in building up American merchant marine insurance companies," thereby touching upon a subject regarding which, as has been indicated in these columns, Congress has shown an increasing solicitude. Indeed, the merchant marine committee has virtually conveyed a hint to the Shipping Board in calling attention to the fact that two-thirds of the marine insurance of this country is today written in foreign companies and expressing the thought that the Shipping Board may find some way to utilize its patronage to build up American companies to such an extent that the enormous expenditures in premiums in this line can be retained in the United States.

The Propulsive Efficiency of Single-Screw Cargo Ships*

Effect of Varying Amount of Parallel Middle Body and Longitudinal Coefficient Simultaneously With Constant Over-All Dimensions

BY COMMANDER WILLIAM MC ENTEE, CONSTRUCTION CORPS, U. S. N.

IN A PAPER** read before the last meeting of the Society giving the results of a series of experiments made at the U. S. Experimental Model Basin with models of single-screw cargo ships it was shown among other things that for good propulsive efficiency it was necessary to have the run finer than the entrance, and for vessels of this class having a parallel middle body equal to about one-third the length of the ship, the minimum power is required when the fore-and-aft position of the parallel middle body is such that about two-thirds of it is forward of the midship section and one-third abaft it. Those results, which it is believed were the first of any extensive series of experiments with self-propelled models of single-screw ships to be made public, were confirmed by a somewhat similar series of tests made at Clydebank on models of vessels of the same general class. The results of the latter tests were presented in a paper† by Mr. James Semple before the Institution of Naval Architects in April, 1919.

In view of the importance of this class of vessel it was considered desirable to extend the investigation, and the present paper contains the results of the tests of five additional models, the characteristics of which are given in the following table:

TABLE 1

Model No.	Longitudinal coefficient	% of parallel middle body	Run in % of length	Displacement —tons
2181	0.74	30	38.70	12,341
2182	0.76	35	37.03	12,675
2183	0.78	40	35.37	13,009
2184	0.80	45	33.70	13,344
2185	0.82	50	32.03	13,678

The lines of the parent form, Model No. 2023, are shown in Fig. 1. In Fig. 2 are shown the sectional area curves for the five models and the parent form.

The investigation had for its object determination of the effect of varying the amount of parallel middle body and the longitudinal coefficient simultaneously while maintaining the principal over all dimensions. In other words, the investigation sought to obtain data from which it would be possible at any given practicable speed for a cargo carrier to determine the economic possibilities of increasing the displacement by increasing the parallel middle body and longitudinal coefficient. A great many vessels of this character now built have coefficients ranging from 0.78 to 0.80, and the question to be determined was the economic limit of fullness so far as coefficient and displacement are concerned for a vessel of a given length, beam, and draft. In the five models tested the longitudinal coefficient varied by increments of 0.02 from 0.74 to 0.82.

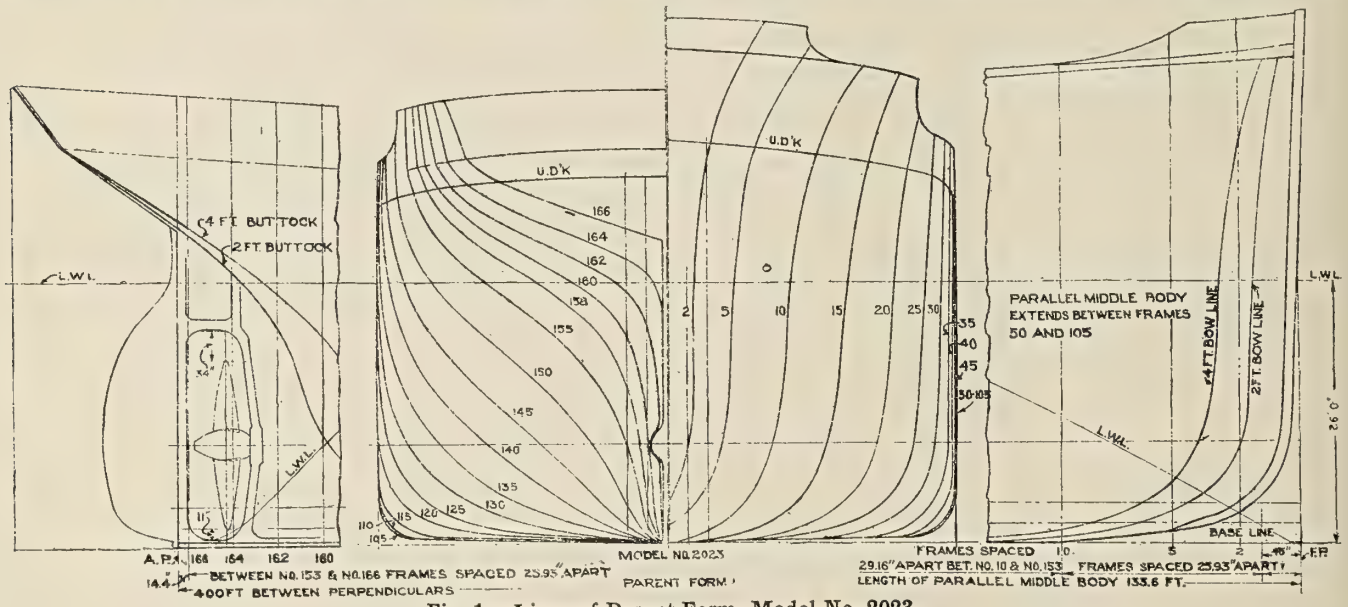


Fig. 1.—Lines of Parent Form, Model No. 2023

As mentioned in last year's paper, previous experiments at the Experimental Model Basin have shown that, for a single-screw cargo ship of about 0.78 coefficient, it is desirable to use a parallel middle body of about one-third the length. For simplicity in construction, however, it is desirable to use a somewhat greater length of parallel middle body. It is possible to use with this coefficient a parallel middle body of about 40 percent of the ship's length without much sacrifice in power. This consideration determined the extent of parallel middle body for each model as given in Table 1. Comparison of results of the present series with last year's results shows that an increase of parallel middle body from 33 percent to 42 percent causes an increase in effective horsepower of but 3 percent only.

In order to keep the run fine, the fore-and-aft distribution of the parallel middle body was retained the same as had previously shown the best results; that is, one-third

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November 14, 1919.

**"Variation of Shaft Horsepower, Propeller Revolutions and Propulsive Coefficient with Longitudinal Position of the Parallel Middle Body in a Single-Screw Cargo Ship."

†"Experiments on Full Cargo Ship Models."

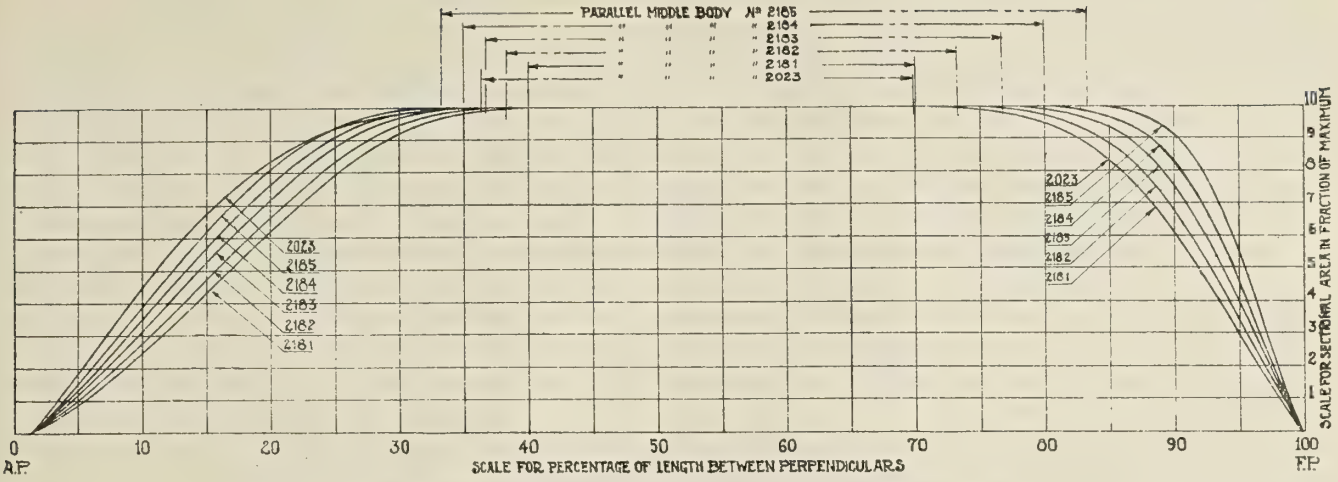


Fig. 2.—Sectional Area Curves of Five Models and Parent Form

abaft the midship section and two-thirds forward of it. This distribution possibly gives for the higher coefficient a model which is too bluff at the entrance, especially at the higher speeds. For the lower speeds, the distribution of sectional area seems to be satisfactory, particularly as regards eddying at the stern, which is liable to occur with vessels of full coefficient.

The following are the dimensions of the propeller used in the experiments and also the dimensions expanded to the ship scale:

	Model	Ship
Diameter	10.125 inches	16 feet 7 inches
Pitch	9.0 inches	14 feet 9 inches

Pitch ratio	0.889
Mean width ratio	0.20
Number of blades	3
Ratio of projected to disk area	0.266
Blade thickness fraction	0.04

The propeller had three blades of Taylor's standard form.

The propeller characteristics were obtained by separate tests of the propeller model run in free water, that is, in a separate apparatus where the propeller shaft projected well ahead, so that the propeller ran in water undisturbed by the action of the testing apparatus. The same motor dynamometer was used for tests as was used for the self-propulsion tests, the only difference being that the propeller shaft was coupled to the forward end of the armature shaft instead of the after end.

The characteristics of the propeller are given in Fig. 3. The thrust constant, C_t, and the torque constant, C_q, are plotted on nominal slip following the method used by Schaffran.* These constants, which are in non-dimensional form, lend themselves well to the analysis of self-propulsion experiments and to the extension of the results to the full-size ship.

The results of the investigation are given in Figs. 4, 5 and 6. An examination of the estimated horsepower curves and the shaft horsepower curves for the various models shows, as was to be expected, wide variation in power requirements, especially at higher speeds. For example, at 11 knots passing from Model 2181 longitudinal coefficient 0.74 to Model 2185 longitudinal coefficient 0.82, with a change in displacement of 1,337 tons, or 10.8 percent, increases the effective horsepower from 1,165 to 1,585 or 36 percent, while the shaft horsepower is increased by 950 or 54 percent. In this range the percentage increase in effective horsepower required is about three and one-half times as much as the increase in displacement, while the increase in shaft horsepower is five times as great as that in displacement. At a speed of 11 knots the increased displacement is obtained by an apparently unwarranted increase in power. This results from the fact that the natural increase in effective horsepower resulting from the larger displacement and coefficient is magnified or augmented by an accompanying fall in the propulsive coefficient from 0.665 to 0.587.

In the tests the same propeller was used on all models, and it may be considered that the propeller is too small for the ship represented by Model 2185, as the revolutions per minute have increased from 84.5 to 93.2. This is to some extent true, but separate estimates indicate that if a propeller of different diameter or pitch were fitted to

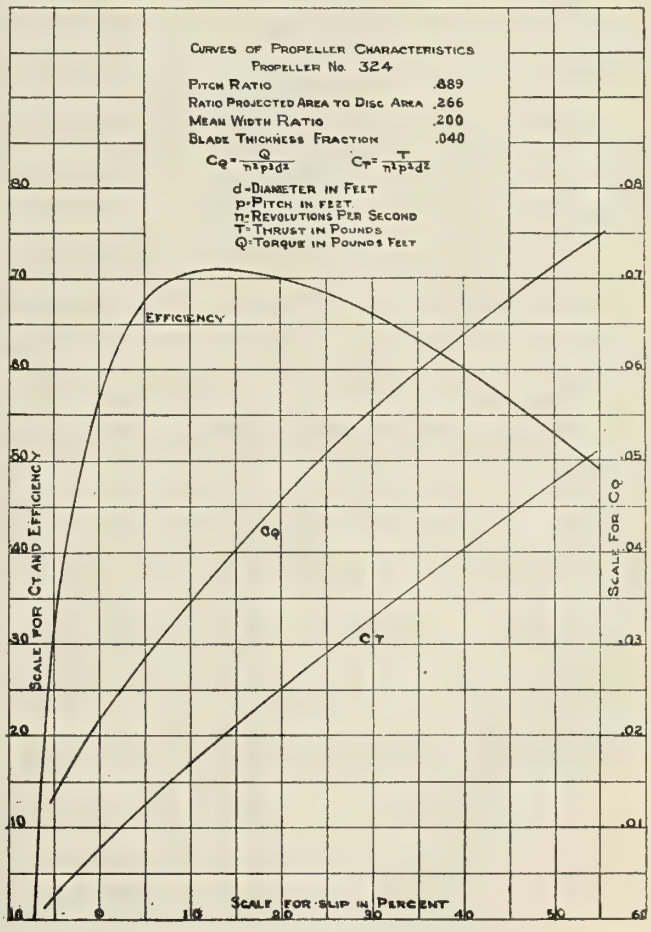


Fig. 3.—Characteristics of Propeller

*"Systematische Propellerversuche;" K. Schaffran, *Schiffbau*, September 22, 1915.

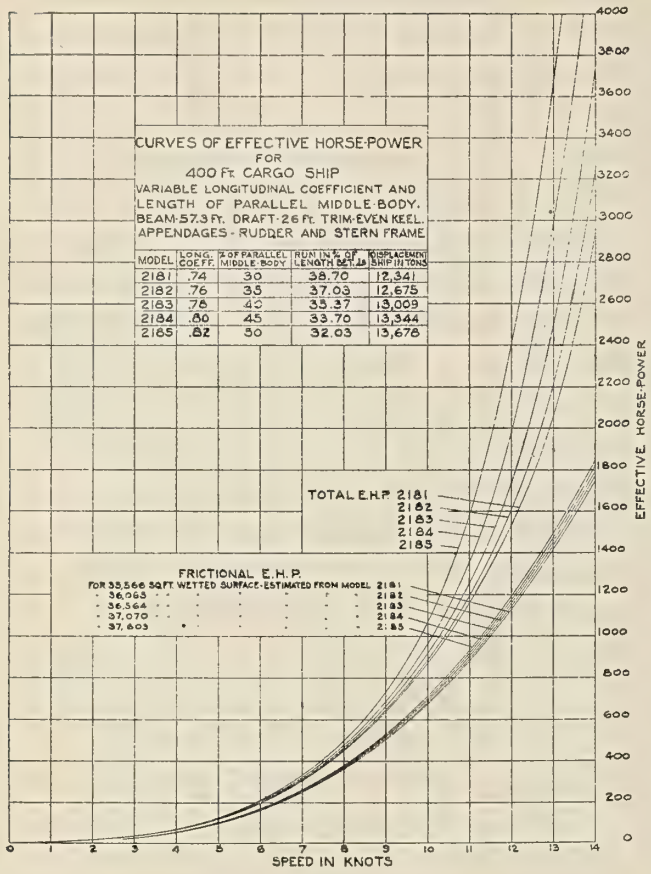


Fig. 4

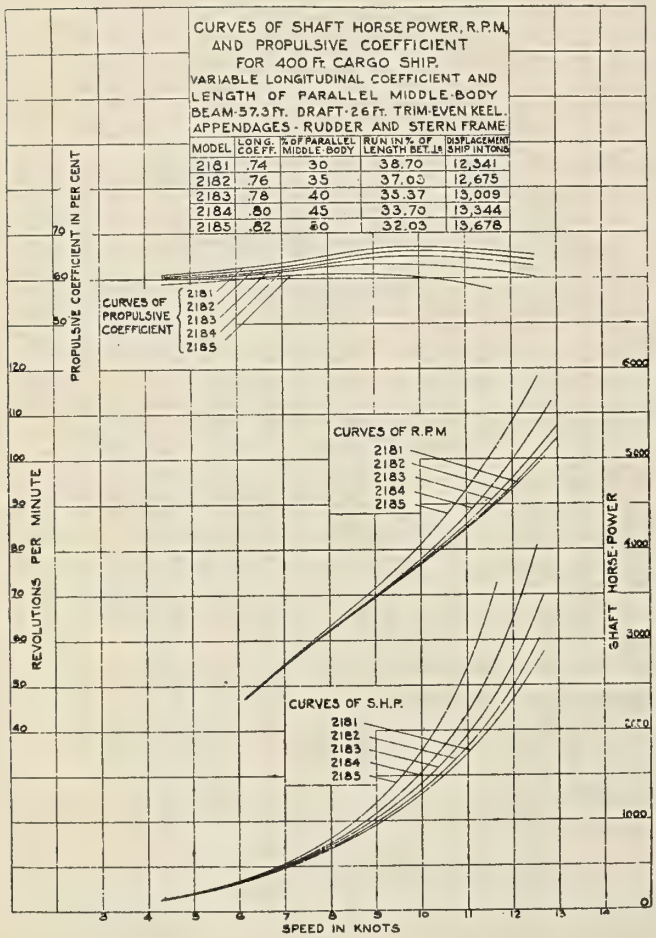


Fig. 5

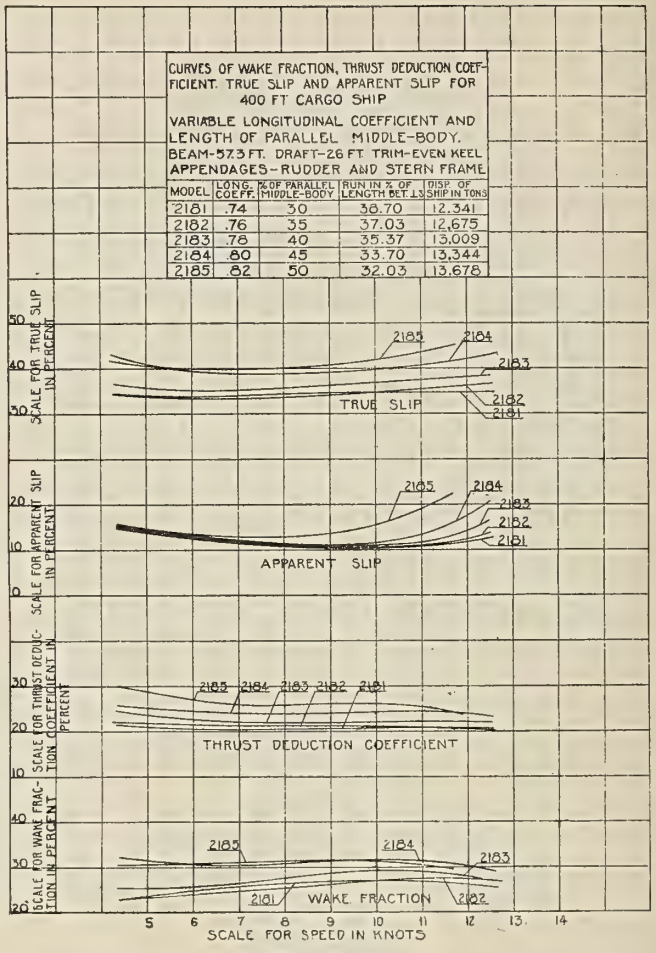


Fig. 6

2185 for the purpose of reducing the revolutions to 84.5, such change would make but little change in the propulsive coefficient, not over one percent, so for all practical purposes the models may be compared on the basis of the shaft horsepower curves shown in Fig. 5, without taking the revolutions into consideration.

As another comparison of these results, it is interesting to consider the effect of increasing the longitudinal coefficient and displacement of the ship represented by Model 2183. The curves show that at a speed of 11 knots an increase of longitudinal coefficient from 0.78 to 0.80 with a corresponding increase in displacement of 335 tons or 2.57 percent requires an 8 percent increase in effective horsepower and 12.27 percent increase in shaft horsepower. Of the increased displacement, only a part would be available as cargo-carrying capacity, depending upon the necessary increase in the weight of the hull, machinery, and fuel. On a given trade route, with a knowledge as to the cost of fuel and other expenses proportional to the power, it may readily be determined whether the additional cargo carried for the additional displacement would be economically possible with the increased power charges.

In Fig. 6 are shown the curves of wake fraction, thrust deduction coefficient, apparent slip and true slip for the ships. In extending the results of the model experiments to the full-sized ships it has been assumed that the wake fraction and thrust deduction coefficient for the ships are the same as for the models.

As the American practice in defining the wake as a percentage of the ship's speed varies from that followed in Great Britain, the following definitions of the thrust deduction coefficient and the wake fraction are given:

$$t = \frac{T-R}{T}; \quad w = \frac{V-V'}{V},$$

in which T is the thrust of the propeller, R the resistance of the ship, V the speed of the ship, V' the speed of advance of the propeller in the water in which it works.

With regard to the shaft horsepower required for the ships represented by the different models, it should be noted that the curves show what may be expected under trial conditions, that is, with a clean, freshly painted bottom and a smooth bronze propeller running in smooth water. To maintain the same sea speed over considerable periods, it is necessary to allow a margin of power to cover the increased resistance due to average sea and weather conditions and a moderate amount of fouling of bottom, which occurs between each docking and painting.

Summing up the results of both series of experiments, it appears safe to conclude that, for a well-designed hull with a propeller running at about 90 revolutions per minute, a hull efficiency of 1.09 and a propulsive efficiency of 0.65 may be expected in a single-screw cargo ship.

Economical Cargo Ships*

Cost of Operation at Four Different Speeds of Four Standard Vessels of Different Sizes

BY ALFRED J. C. ROBERTSON

THE circumstances of the late war and the necessity of largely rebuilding the shipping trade of the world have called the attention of naval architects to the need of a careful mathematical and scientific analysis of the cost of operation of ships, and, as a result, several investigators have recently given us the benefit of valuable papers on the subject. Particular reference might be made to the paper by Mr. John Anderson to the Institution of Naval Architects, London, March 20, 1918; by Alexander Urwin to the Northeast Coast Institution of Engineers and Shipbuilders, January 14, 1919; and by Messrs. G. S. Baker and J. L. Kent to the Institution of Engineers and Shipbuilders in Scotland, February 18, 1919.

Mr. Anderson, in his paper, devotes special attention to working out a theory of operating efficiency based on the number of cargo derricks and winches that can be used and the derrick speed which can be employed in loading or unloading vessels. Mr. Urwin tabulates in a very methodical manner the various elements that go to produce an efficiency figure, and has given us one or two examples worked out. Messrs. Baker and Kent have also treated the matter in this way, but, in addition, give considerable attention to the actual ship form for economical movement of freight.

In the opinion of the writer greater progress could probably be made if naval architects were able to place before ship operators the actual operating costs under certain assumed conditions and with various combinations of size, speed and form of ship. Figures compiled in this way showing the cost of operation for certain German ships on four stated routes were published in Shipbuilding and Shipping Record of January 2, 1918, and figures have also been compiled by the United States Shipping Board covering the operation of certain ships over various routes. In each case, however, these figures were for vessels varying in their general characteristics, and it appears to the writer that any true comparison can only be made if the variation in the characteristics of the vessels is directly limited to that feature which it is desired to investigate. He has therefore prepared some calculations in this direction and takes the liberty of placing before the Society of Naval Architects and Marine Engineers such figures and results as he thinks may prove of value.

The method adopted has been to take vessels of four different sizes, of standard proportions, and to work out on the same basis the first cost and the cost of operation for each vessel at each of four different speeds. In addition, the writer has investigated particular features in the cost of operation for one or more sizes of ship. The scope of this series of calculations for an assumed length of route of 3,500 nautical miles between fueling ports is shown herewith, each size of ship being investigated for 10 knots, 11 knots, 12 knots and 13 knots sea speed, using oil as fuel, except as noted:

(*A*) Block coefficient chosen for each specific speed.

1. With minimum port detention; length of ship, 350 feet, 400 feet, 450 feet, and 500 feet.
2. Minimum port detention, coal burning; length of ship, 500 feet.
3. Minimum port detention, concrete ship; length of ship, 500 feet.
4. Double port detention; length of ship, 350 feet and 500 feet.
5. Minimum port detention, with 10 percent increased resistance, 500-foot ship.

(*B*) Fixed block coefficient for all speeds.

6. Minimum port detention; fine model, 500-foot ship.
7. Minimum port detention; full model, 500-foot ship.

Each of these ships was investigated for fuel rates of $6.00 and $12.00 with tonnage dues, and with a fuel rate of $6.00 figures were also calculated without tonnage dues. In addition to the above calculations, another series was made with a steaming distance of 7,000 nautical miles between ports, but as the character of the results was the same throughout, the investigation for this length of run was not made so complete. Such figures as the author thinks would be of interest for the 3,500 nautical mile haul are given in Plate 1.

In order to extend these calculations, a very considerable number of assumptions had to be made, as follows:

(*a*) *Proportions.*—The length of the vessel was taken as the waterline length, which would also be the length between perpendiculars for twin-screw vessels. The length between perpendiculars for single-screw vessels would be somewhat greater than the figures given.

The breadth molded was taken as equal to .10 of the length on waterline, plus 14 feet, this proportion giving ample beam for stability even with a considerable amount of superstructure.

The load draft in each case was chosen to give a breadth upon draft ratio of 2.25, which is approximately the best ratio for economical propulsion.

(*b*) *Speed and Power.*—The speed in each case is such

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November 13, 1919.

Plate 1.—Data for 3,500 Nautical Mile Voyage

			350-Foot Ships, Minimum Port Detention				350-Foot Ships, Double Port Detention				400-Foot Ships, Minimum Port Detent.				450-Foot Ships, Minimum Detention			
1	Column No. 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2	Length on Waterline	Feet	350'-0	350'-0'	350'-0'	350'-0'	350'-0'	350'-0'	350'-0'	350'-0'	400'-0'	400'-0'	400'-0'	400'-0'	450'-0'	450'-0'	450'-0'	450'-0'
3	Breadth	"	49'-0	49'-0'	49'-0'	49'-0'	49'-0'	49'-0'	49'-0'	49'-0'	54'-0'	54'-0'	54'-0'	54'-0'	59'-0'	59'-0'	59'-0'	59'-0'
4	Load Draft	"	21'-3½	21'-3½	21'-3½	21'-3½	21'-3½	21'-3½	21'-3½	21'-3½	24'-0'	24'-0'	24'-0'	24'-0'	26'-2½	26'-2½	26'-2½	26'-2½
5																		
6	Speed on Service	Knots	10.0	11.0	12.0	13.0	10.0	11.0	12.0	13.0	10.0	11.0	12.0	13.0	10.0	11.0	12.0	13.0
7	Speed-Length Ratio	$\frac{V}{\sqrt{L}}$	.535	.587	.641	.695	.535	.587	.641	.695	.50	.55	.60	.65	.471	.518	.565	.613
8	Block Coefficient	C_B	.768	.740	.712	.689	.768	.740	.712	.689	.783	.762	.734	.711	809	782	755	731
9	Load Displacement	Tons	8,196	7,897	7,599	7,353	8,196	7,897	7,599	7,353	11,686	11,286	10,872	10,531	16,090	15,553	15,016	14,539
10	Indicated Horse Power	I.H.P.	1,566	1,970	2,470	3,028	1,566	1,970	2,470	3,028	2,021	2,515	3,121	3,862	2,600	3,200	3,877	4,749
11	Ratio: Tons Displ. per I.H.P.	Tons	5.234	4.008	3.076	2.428	5.234	4.008	3.076	2.428	5.782	4.487	3.483	2.727	6.188	4.860	3.873	3.061
12																		
13	Weight of Hull and Outfit	Tons	2,108	2,081	2,055	2,034	2,108	2,081	2,055	2,034	3015	2,978	2,941	2,909	4,166	4,119	4,069	4,026
14	Weight of Propelling M/cy	"	392	492	618	757	392	492	618	757	505	629	780	966	650	800	969	1,187
15	Total Deadweight	"	5,696	5,324	4,926	4,562	5,696	5,324	4,926	4,562	8,166	7,679	7,151	6,656	11,274	10,634	9,978	9,326
16	Ratio: Deadweight to Displ.	"	.695	.675	.648	.620	.695	.675	.648	.620	.699	.680	.658	.632	701	684	.664	641
17																		
18	Cost of Hull and Outfit	$	580,750	574,000	567,500	562,250	580,750	574,000	567,500	562,250	833,750	824,500	815,250	807,250	1,155,250	1,143,500	1,131,000	1,120,250
19	" " Propelling Machinery	"	203,580	256,100	321,100	393,640	203,580	256,100	321,100	393,640	262,730	326,950	405,730	502,060	338,000	416,000	504,010	617,370
20	" " Ship	"	784,330	830,100	888,600	955,890	784,330	830,100	888,600	955,890	1,096,480	1,151,450	1,220,980	1,309,310	1,493,250	1,559,500	1,635,000	1,737,620
21	" " " Per Ton Deadwt.	"	137.70	155.91	180.39	209.63	137.70	155.91	180.39	209.63	134.27	149.95	170.74	196.71	132.46	146.69	163.85	186.32
22																		
23	Fuel Consumed per Voyage	Tons	265	300	342	384	286	320	362	404	346	387	436	494	446	494	545	611
24	Stores and Fresh Water	"	132	150	171	192	142	160	181	202	173	193	218	247	223	247	272	305
25	Cargo Deadweight	"	5299	4874	4413	3986	5269	4844	4383	3956	7647	7099	6497	5915	10,605	9,893	9,161	8,410
26																		
27	Time on Voyage	Days	14.58	13.26	12.15	11.22	14.58	13.26	12.15	11.22	14.58	13.26	12.15	11.22	14.58	13.26	12.15	11.22
28	" In Port	"	5.15	5.15	5.15	5.15	10.30	10.30	10.30	10.30	5.80	5.80	5.80	5.80	6.50	6.50	6.50	6.50
29	" For Annual Overhaul	"	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
30																		
31	Number of Trips per Year		16.97	18.20	19.36	20.46	13.46	14.22	14.92	15.57	16.44	17.58	18.66	19.68	15.89	16.95	17.96	18.90
32	Time on Voyage per Year	Days	247.4	241.3	235.2	229.6	196.4	188.5	181.3	174.6	239.7	233.1	226.7	220.8	231.7	224.8	218.2	212.1
33	Time in Port per Year	"	117.6	123.7	129.8	135.4	168.6	176.5	183.7	190.4	125.3	131.9	138.3	144.2	133.3	140.2	146.8	152.9
34	Percentage Time under Way	%	67.8	66.1	64.4	62.9	53.8	51.6	49.7	47.8	65.7	63.9	62.1	60.5	63.5	61.6	59.8	58.1
35																		
36	Cost of Manning and Manager P.A.	$	72,915	72,915	72,915	72,915	72,915	72,915	72,915	72,915	81,300	81,300	81,300	81,300	98,490	98,490	98,490	98,490
37	Depreciation, Insurance, Upkeep, P.A.	"	101,963	107,913	115,518	124,266	101,963	107,913	115,518	124,266	142,542	149,688	158,727	170,210	194,122	202,735	212,550	226,891
38	Fuel Oil @ $6.00 a Ton, per Annum	"	26,588	32,760	39,727	47,141	23,017	27,302	32,406	37,742	34,130	40,822	48,815	58,332	42,322	50,241	58,729	69,290
39	Dues @ $1.50 per Nett Ton, P.A.	"	69,543	71,854	73,549	75,211	55,159	56,155	56,681	57,235	96,059	99,204	101,436	103,615	127,835	131,803	134,844	137,384
40																		
41	Annual Fuel @ $6.00 No Dues	$	201,866	213,588	228,160	244,322	197,895	208,130	220,839	234,922	257,972	271,810	288,842	309,842	335,134	351,466	369,769	393,671
42	Cost of " " With Dues	"	271,409	285,442	301,709	319,533	253,054	264,285	277,520	292,158	354,031	371,014	390,278	413,457	462,969	483,269	504,613	531,055
43	Operation @ $12.00 " "	"	298,397	318,202	341,436	366,674	276,071	291,587	309,926	329,900	388,161	411,836	439,093	471,789	505,491	533,510	563,342	600,345
44																		
45	Cargo moved P.A. per $1,000,000	Tons	114,650	106,863	96,146	81,553	90,422	82,980	73,592	64,437	114,655	108,385	99,344	88,907	112,835	107,625	100,742	91,475
46																		
47	Cost of Operating ($6 Fuel, No Dues	$	257,374	257,304	256,763	255,596	262,311	250,729	248,525	245,763	235,273	236,059	236,565	236,645	224,433	225,371	226,158	226,557
48	Per Annum per Million " $6 " With "	"	346,039	343,864	339,533	334,278	322,637	318,377	312,311	305,640	322,879	322,215	319,643	315,782	310,041	309,887	308,632	305,622
49	Dollars Investment ($12 " "	"	380,440	383,329	384,240	383,594	351,983	351,267	348,780	345,123	354,006	357,667	359,623	360,334	338,517	342,103	344,551	345,498
50																		
51	Profit P.A. per $1,000,000 $6 Fuel, No Dues	$	298,678	260,981	205,545	139,936	186,236	151,724	108,396	66,756	320,804	289,608	245,253	194,554	322,817	296,125	262,441	217,097
52	Investment @ $6.00 per $6 " With "	"	210,013	174,421	126,775	61,254	115,910	84,076	44,610	6,875	233,198	203,452	162,175	115,417	237,209	211,609	173,967	138,032
53	Ton, less $1.00 Handl. & 15% Comm. $12 " "	"	175,612	134,556	82,068	11,938	86,564	51,186	8,141	Loss 32,604	202,071	168,000	122,195	70,865	208,733	179,393	144,048	98,156
54																		
55																		

Plate 1.—(Continued)

500-FOOT SHIPS, MINIMUM DETENTION				500-FOOT SHIPS, DOUBLE DETENTION				500-FOOT SHIPS, 10% GREATER POWER				500-FOOT SHIP, BLOCK COEFF. ·750				500-FOOT SHIP, BLOCK COEFF ·825			
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"	500'-0"
64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"	64'-0"
28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"	28'-5¼"
10·0	11·0	12·0	13·0	10·0	11·0	12·0	13·0	10·0	11·0	12·0	13·0	10·0	11·0	12·0	13·0	10·0	11·0	12·0	13·0
·447	·491	·536	·581	·447	·491	·536	·581	·447	·491	·536	·581	·447	·491	·536	·581	·447	·491	·536	·581
·825	·80	·775	·750	·825	·80	·775	·750	·825	·80	·775	·750	·750	·750	·750	·750	·825	·825	·825	·825
21,452	20,802	20,152	19,500	21,452	20,802	20,152	19,500	21,452	20,802	20,152	19,500	19,500	19,500	19,500	19,500	21,452	21,452	21,452	21,452
3,254	3,994	4,825	5,828	3,254	3,994	4,825	5,828	3,573	4,393	5,308	6,411	2,582	3,460	4,519	5,828	3,254	4,032	5,935	8,215
6·592	5·208	4·176	3·345	6·592	5·208	4·176	3·345	5·993	4·735	3·797	3·041	7·552	5·636	4·315	3·346	6·592	5·320	3·614	2·611
5,626	5,568	5,506	5,448	5,626	5,568	5,506	5,448	5,626	5,568	5,506	5,448	5,448	5,448	5,448	5,448	5,626	5,626	5,626	5,626
814	998	1,206	1,457	814	998	1,206	1,457	895	1,098	1,327	1,603	1,457	1,457	1,457	1,457	2,054	2,054	2,054	2,054
15,012	14,236	13,440	12,595	15,012	14,236	13,440	12,595	14,931	14,136	13,319	12,449	12,595	12,595	12,595	12,595	13,772	13,772	13,772	13,772
·700	684	666	·646	·700	684	·666	646					·646	·646	·646	·646	·642	·642	·642	·642
1,562,750	1,548,250	1,532,750	1,518,250	1,562,750	1,548,250	1,532,750	1,518,250	1,562,750	1,548,250	1,532,750	1,518,250	1,518,250	1,518,250	1,518,250	1,518,250	1,562,750	1,562,750	1,562,750	1,562,750
423,020	519,220	627,250	757,640	423,020	519,220	627,250	757,640	465,323	571,142	685,975	833,404	757,640	757,640	757,640	757,640	1,067,950	1,067,950	1,067,950	1,067,350
1,985,770	2,067,470	2,160,000	2,275,890	1,985,770	2,067,470	2,160,000	2,275,890	2,028,073	2,119,392	2,222,725	2,351,654	2,275,890	2,275,890	2,275,890	2,275,890	2,630,700	2,630,700	2,630,700	2,630,700
132^{27}	145^{23}	160^{71}	180^{67}	132^{27}	145^{23}	160^{71}	180^{67}	135^{02}	149^{22}	166^{88}	188^{39}	180^{67}	180^{67}	180^{67}	180^{67}	191^{02}	191^{02}	191^{02}	191^{02}
558	620	678	751	583	670	728	801	614	682	746	826	454	543	640	751	559	623	824	1038
270	310	339	375	291	335	364	400	307	341	373	413	227	271	320	375	279	312	412	519
14,175	13,306	12,423	11,469	14,138	13,231	12,348	11,394	14,010	13,113	12,200	11,210	11,914	11,781	11,635	11,469	12,934	12,837	12,536	12,215
14·58	13·26	12·15	11·22	14·58	13·26	12·15	11·22	14·58	13·26	12·15	11·22	14·58	13·26	12·15	11·22	14·58	13·26	12·15	11·22
7·25	7·25	7·25	7·25	14·50	14·50	14·50	14·50	7·25	7·25	7·25	7·25	7·25	7·25	7·25	7·25	7·25	7·25	7·25	7·25
30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00	30·00
15·34	16·33	17·26	18·14	11·52	12·07	12·57	13·02	15·34	16·33	17·26	18·14	15·34	16·33	17·26	18·14	15·34	16·33	17·26	18·14
223·7	216·5	209·7	203·5	168·0	160·0	152·7	146·2	223·7	216·5	209·7	203·5	223·7	216·5	209·7	203·5	223·7	216·5	209·7	203·5
141·3	148·5	155·3	161·5	197·0	205·0	212·3	218·8	141·3	148·5	155·3	161·5	141·3	148·5	155·3	161·5	141·3	148·5	155·3	161·5
61·3	59·3	57·5	55·7	46·0	43·8	41·8	40·0	61·3	59·3	57·5	55·7	61·3	59·3	57·5	55·7	61·3	59·3	57·5	55·7
106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176	106,176
258,150	268,771	280,800	295,865	258,150	268,771	280,800	295,865	263,649	275,521	288,954	305,715	295,865	295,865	295,865	295,865	341,991	341,991	341,991	341,991
51,358	60,750	70,214	81,739	40,297	48,521	54,906	62,574	53,712	66,822	77,235	89,913	41,786	53,203	66,278	81,739	51,450	61,041	85,333	112,576
156,385	169,848	173,312	176,865	123,563	125,540	126,655	126,945	156,385	169,848	173,312	176,865	149,565	159,217	168,285	176,865	164,552	175,172	185,148	194,588
415,684	435,697	457,190	483,780	404,623	423,468	441,882	464,615	423,537	448,519	472,365	501,804	443,827	455,244	468,319	483,780	419,617	509,208	533,500	561,143
572,069	605,545	631,102	660,645	528,186	549,008	568,537	591,560	579,922	618,367	646,277	678,669	593,392	614,461	636,604	660,645	664,169	684,380	718,648	755,731
623,427	666,295	701,316	742,384	568,483	597,529	623,443	654,134	633,634	685,189	723,512	768,582	635,178	667,664	702,882	742,384	715,619	745,421	803,981	868,707
103,501	105,098	99,269	91,414	82,018	73,243	71,858	65,183	105,969	101,036	94,736	86,471	89,303	84,531	88,238	91,414	75,420	79,685	82,248	84,228
209,331	210,739	211,662	212,568	203,761	204,824	204,575	204,146	208,857	211,626	212,516	213,383	195,013	200,030	205,775	212,568	189,918	193,564	202,798	213,306
288,084	292,891	292,176	290,280	265,985	265,546	263,211	259,925	285,947	291,766	290,753	288,592	260,730	269,988	279,717	290,280	252,469	260,151	273,177	287,274
313,947	322,275	324,683	326,196	286,278	285,015	288,631	287,419	312,431	323,295	325,507	326,826	279,091	293,365	308,839	326,196	272,026	283,355	305,615	330,219
321,749	298,986	269,793	230,790	194,018	169,804	143,936	111,991	305,143	278,398	246,954	206,001	194,457	209,945	222,179	230,790	175,869	192,908	196,105	195,200
242,396	216,834	189,279	153,078	131,802	109,082	85,300	56,212	228,003	196,259	168,711	130,792	128,740	139,587	148,237	153,078	113,318	126,321	125,725	121,232
217,133	187,450	156,772	117,162	111,509	85,613	59,880	28,718	201,519	166,730	133,963	92,558	110,379	116,610	119,115	117,162	93,761	103,117	93,288	78,287
																			A.J.C.R.

Plate 2.—Results of Calculations

Fig. 1

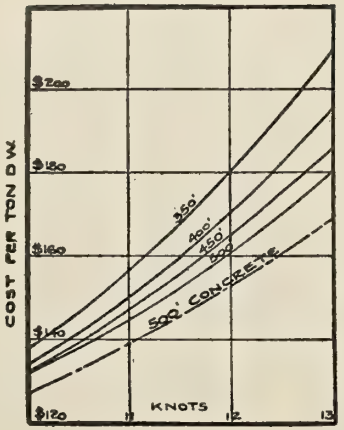
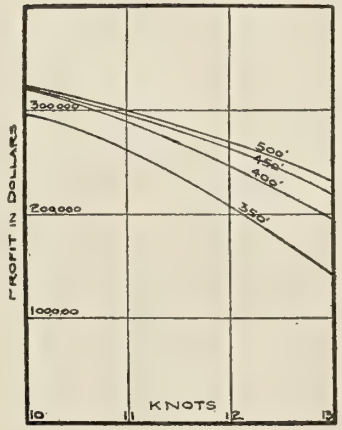
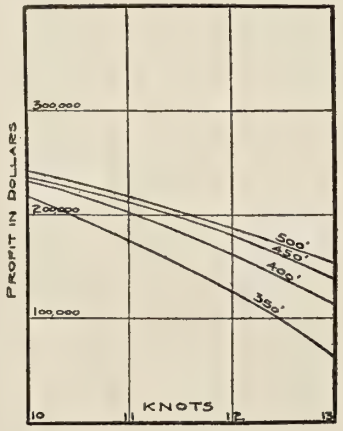


Fig. 2



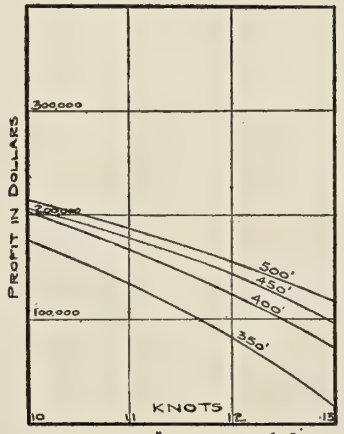
OIL FUEL @$6.00 NO DUES

Fig 3



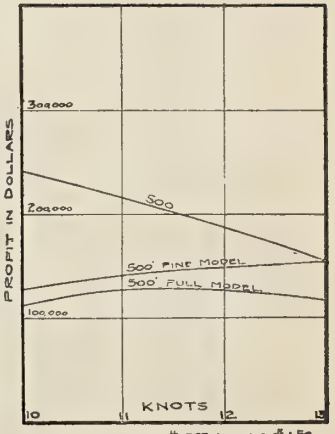
OIL FUEL @$6.00, DUES 1.50

Fig. 4



OIL FUEL $12.00, DUES $1.50

Fig. 5



OIL FUEL $6.00 DUES $1.50

Fig. 6.

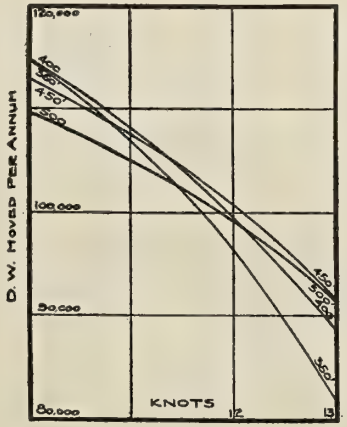
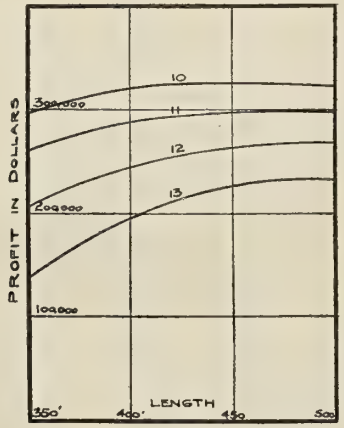
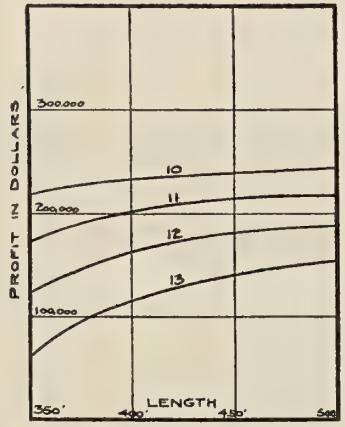


Fig. 7.



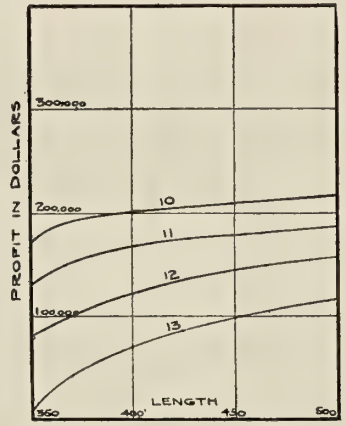
OIL FUEL $6.00 NO DUES

Fig. 8.



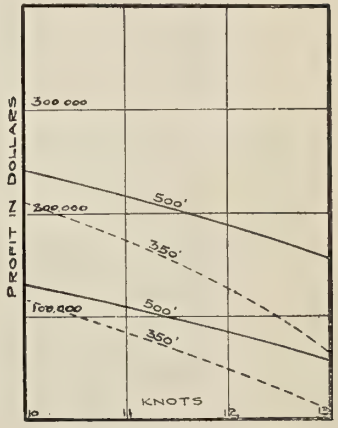
OIL FUEL $6.00 DUES $1.50

Fig. 9



OIL FUEL $12 DUES $1.50

Fig. 10.



DOUBLE DETENTION AT PORT.
WITH OIL FUEL $6.00 DUES $1.50

as could be maintained in any ordinary weather at sea. The power was arrived at in each case from tank test data, a propulsive coefficient of 52 percent being assumed and a margin of power allowed to maintain the required speed at sea. A discount of 20 percent from the figures given for indicated horsepower should be made to arrive at the horsepower on a smooth-water trial trip fully loaded.

(*c*) *Weight of Ship.*—The weight of the steel hull has been found to vary slightly with the block coefficient, and this variation has been allowed for. The weight of outfit corresponds to a first class specification and has been taken as identical for each length of vessel, irrespective of speed. The engine room weights are taken as varying directly with the horsepower, taking 4 horsepower to each ton of engine room machinery. The total deadweight was assumed to be the difference between displacement and the sum of steel hull, outfit, and engine room weights.

(*d*) *Cost of Ships.*—The cost of the steel hull was assumed to vary directly with the weight of steel used, and the cost of outfit was taken as constant for each size of ship. The cost of propelling machinery is based directly upon the horsepower developed; and the basis of these costs was so chosen that the 400-foot ship, at 11 knots speed, would show a cost of approximately $150.00 per deadweight ton.

(*e*) *Weight of Fuel and Stores.*—The fuel oil consumed was figured at one pound per indicated horsepower per hour, plus a fixed amount for each size of vessel in port. The port fuel consumption allowed for minimum detention was taken as 20 tons for the 350-foot ship, 30 tons for the 400-foot ship, 40 tons for the 450-foot ship and 50 tons for the 500-foot ship. A figure was taken for fresh water, make-up feed, and consumable stores equal to one-half the weight of the fuel oil required per voyage.

In fixing a fuel rate per ton of oil fuel it is intended that this figure should cover also the cost of lubricating oil, fresh water and similar charges based on the horsepower of the engine. For this reason $6.00 and $12.00 as fuel rates would represent a cost somewhat lower than this for the oil alone.

(*f*) *Port Detention.*—The time in port is of great importance in the estimated cost of operation of a ship. This is a variable figure, and calculations are given showing the effect with minimum detention and with a detention equal to twice the minimum. I have taken a figure for the minimum length of time in which a vessel should be detained in port as depending on the quantity of cargo which must pass through every square foot of hatch. This quantity, of course, with similarly designed ships, depends directly upon the depth of the ship, and I have therefore allowed one day in port for every 5 feet in depth of ship, as a minimum port detention figure. In addition to the above port detention, thirty days per annum have been allowed for overhaul.

(*g*) *Operating Expenses.*—The cost of crew is estimated from the United States Shipping Board's rate current at the beginning of this year and includes an allowance of $300.00 per annum per man for sustenance. In addition, a management allowance has been made of $500.00 per month. The cost of manning, however, must be considered as only approximate, as the exact number of crew would depend to a certain extent on design of ship and route.

Depreciation, insurance and up-keep have been figured at 13 percent per annum on the first cost of the vessel. Tonnage dues have been assumed at $1.50 per net ton register, and the assumption has been made, for the sake of comparison, that the net tonnage in each ship would be equal to one-third of the load displacement in tons.

After figuring out the cost of the ship, its deadweight carrying capacity in tons of 2,240 pounds, and cost of operation per annum, these figures have been reduced in each case to the basis of $1,000,000 investment; and in order to make the figures more easily grasped I have assumed a gross freight rate of $6.00 per deadweight ton for the 3,500 nautical mile run. From this rate, however, I have deducted $1.00 per ton for handling and 15 cents per ton brokerage, showing a net revenue of $4.85 per deadweight ton on this run. For the 7,000-mile run I have assumed the freight rate of $10.00 with a deduction of $1.00 per ton for handling and 25 cents per ton for brokerage, giving a net rate of $8.75.

The profits in operation calculated on the above assumptions have in each case been figured upon the assumption that the ships are operated on each leg of their route with a full cargo. This assumption is only a hypothetical one. The freight rate should therefore be so adjusted that it shall bear the proportion to the assumed rate that a full cargo does to the average percentage of cargo carried per trip. For example, if the ship operated with an 80 percent load in one direction and a 20 percent load on the return voyage, 100 percent load is divided between the two voyages, so that only 50 percent freight movement is achieved and the freight rate would therefore be doubled to realize the profits shown on the table, Plate 1.

Results

The results of the calculations are shown in a series of diagrams on Plates 2 and 3 and may be readily summarized as follows:

(*a*) *The Cost Per Deadweight Ton.*—Fig. 1, Plate 2, shows this to be extremely sensitive to speed, increasing rapidly in all sizes of ship with increase of speed. Fig. 11, Plate 3, shows that the cost is only slightly sensitive to increase in size, showing tendency to fall with increase up to about 450 feet at 10 knots and a larger size for faster vessels.

(*b*) *Deadweight Moved Per Million Dollar Investment Per Annum.*—Fig. 6, Plate 2, shows clearly that for large freight movement slow speed is essential. At 10 knots a 350-foot ship will move more cargo than any larger vessel. At 11 knots the 400-foot ship is the best; at 12 knots the 450-foot ship is better, and at 13 knots the 500-foot ship will move as much as any smaller size.

(*c*) *Profits Earned Per Million Dollar Investment.*—Figs. 2, 3 and 4, Plate 2, show the profits earned for a 3,500-knot run as plotted upon speed of ship, and Figs. 12, 13 and 14, Plate 3, are corresponding diagrams for the 7,000-knot run. Figs. 5, 6 and 7, Plate 2, show results for the 3,500-knot run plotted on the size of ship.

All these diagrams show clearly that the slow-speed ship is the money-earning ship, and there is a very steady decline as the speed increases; the 350-foot ship earning twice as much at 10 knots as at 13 knots.

It will be noted from Figs. 7, 8 and 9, Plate 2, that at a speed of 10 knots, a ship 400 feet long gives practically the very best earning proposition that can be designed, and that for 11 knots a length of 450 feet is probably the maximum economical length. These figures, of course, assume the ship to have a capacity cargo, and even a small reduction in this cargo would tell heavily against the larger ships.

These curves completely justify the building of tramp ships between 350 feet and 400 feet in length, with a sea speed of 10 knots.

(*d*) *Form of Ship.*—To compare the effect of a single design run at various speeds, with designs worked up for the individual speeds, calculations were made which are plotted on Fig. 5, Plate 2. The figures for these calculations are shown in columns 32 to 39, Plate 1.

Plate 3.—Reuslts of Calculations

FIG 11.

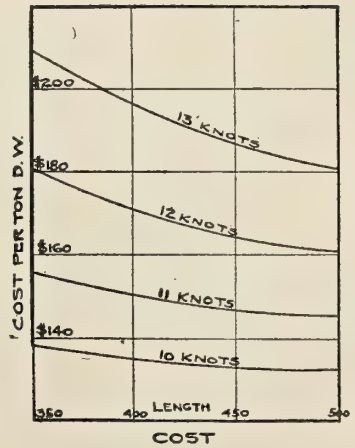


FIG 12.



FIG. 13.

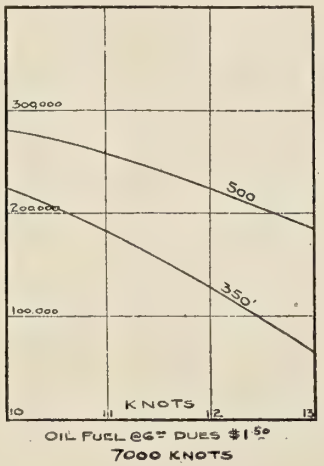


FIG. 14.

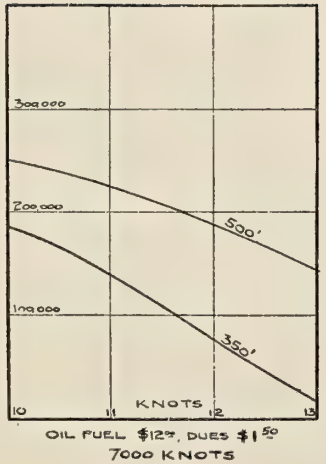


FIG 15.

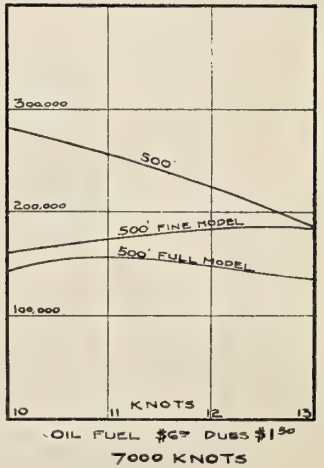


FIG. 16

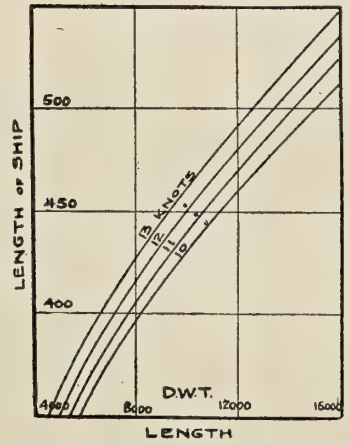


FIG. 17

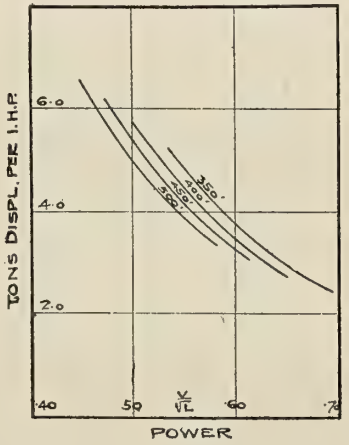


FIG. 18

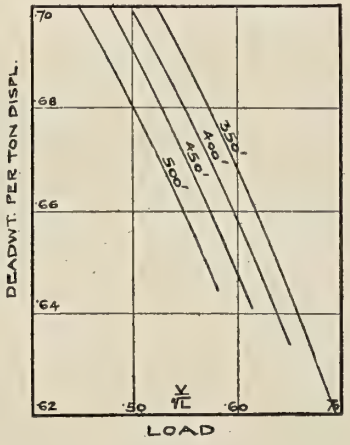


FIG. 19

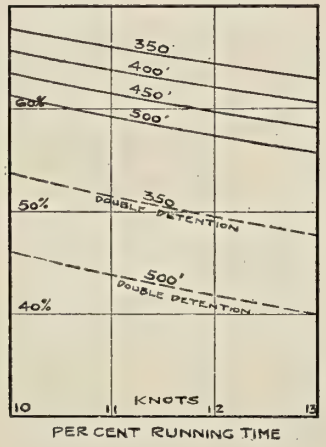
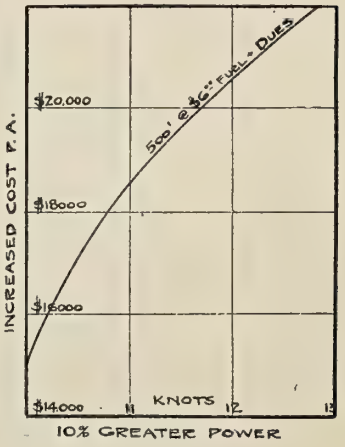


FIG. 20



They show that a vessel designed for a speed of 13 knots, and powered for that speed, will earn more for her owner running up to full speed than at a lower running rate. On the other hand, a vessel designed for 10 knots, with power good for a speed of 13 knots, shows a falling off in earning at speeds over about 11 knots. This diagram clearly shows the advantage of having a ship carefully designed to work under specific conditions.

(*e*) *Value of Model Experiments.*—Fig. 20, Plate 3, shows the actual loss in profit for the 500-foot ship where the power to drive it is 10 percent above the minimum. This 10 percent seems large, but I assure you it is a very modest estimate of the increase of power necessary in a model designed without the use of experimental data. Even careful students of ship resistance might produce a ship design of this kind. This year, for example, we were able to lower the resistance of a 400-foot ship at 10 knots by 8 percent through increasing the displacement by 1½ percent; and in another case, with two ships of identical size and fullness, a slight change in the curve of areas of afterbody made 6½ percent difference in resistance without change of displacement.

The cost to the shipowner of this extra 10 percent is one of the astonishing features of the figures compiled.

At 10 knots the extra power for the 500-foot ship is 325 horsepower, and this gives an actual loss in earning capacity of $16,636.00 per annum, which, at 5 percent compound interest, represents in twenty-five years 79 percent of the cost of the ship, or, in this particular case, $1,610,250.00. At 13 knots the cost is even greater; the 583 additional horsepower costing the ship operator a loss in profit of $24,789.00 per annum, equal to $2,782,230 for the 500-foot 13-knot ship in a life of twenty-five years.

(*f*) *Detention in Port.*—Fig. 10, Plate 2, shows for the 500-foot and 350-foot ships the difference in realized profits if these ships are detained twice as long in port as the ship with which they are compared. Every shipowner is aware that the earning capacity of the ship is measured by its time at sea, but these figures will help to emphasize the necessity for greater care being given to the improvement of the methods of loading and unloading ships.

In Fig. 19, Plate 3, the time at sea is expressed as a percentage of the year, and it is shown that the slow-speed ship can remain at sea for a higher percentage of its life, and to this largely is accountable the superior earning capacity of this type of ship.

(*g*) *Application to Design.*—Figs. 16, 17 and 18, Plate 3, give, respectively, size of ship, power of ship, and capacity of ship for the various speeds and sizes dealt with in this paper. These three diagrams should be of some use for preliminary design work to rapidly approximating the dimensions of a new ship. They are only of definite value, of course, if the proportions and characteristics of the ships are similar to those dealt with in this paper.

(*h*) *Fuel.*—Figures compiled for the 500-foot ship indicate that for the same profits the cost of coal fuel could only be 53 percent of the cost of oil fuel. This figure, of course, includes putting coal in bunkers, and it takes full consideration of the saving in weight and increase in carrying capacity of the ship, due to the use of oil fuel. This economy in oil fuel will not be maintained, of course, if the ships are not running with capacity cargoes.

(*i*) *Concrete Ships.*—The 500-foot ship was calculated also as a concrete ship, and the assumption was made, for the sake of comparison, that depreciation, insurance and up-keep would be at the same rate per annum as the steel ship, viz., 13 percent. On this basis, in order that the concrete ship should show the same operating profits with the steel ship (the cost of machinery being the same), the cost of hull and outfit for the concrete ship at 10 knots should not exceed 79 percent of the cost of the hull and outfit of the steel ship, and at 13 knots it should be limited to 70 percent of the cost of the steel hull and outfit. The cost of a concrete ship per ton of deadweight to show equal profits with the 500-foot steel ship, is shown on Fig. 1, Plate 2.

These figures are on the basis of $6.00 fuel and no dues, but they are approximately true for the other working assumptions.

American Bureau of Shipping Approves Thermit Welding for Marine Repairs

AN important development of thermit welding in American shipyards is anticipated by the recent approval by the American Bureau of Shipping of the thermit process for welding stern frames, rudder frames, and other heavy sections on ships registered under their classification. The only qualification is that this Bureau be notified sufficiently in advance to have a surveyor in attendance during the welding operation as well as to inspect and test the weld when completed.

While the thermit process has been used since 1903 for making marine repairs and has a great many successful welds of this nature to its credit, the process was never officially approved by the American Bureau of Shipping and most of the repairs were made on vessels not classed by them. It is due entirely to the unbroken record of successful marine welds that the Bureau now accords its official sanction to the process. According to a statement by the Metal & Thermit Corporation there has never been a single failure of a thermit marine weld so far as it has been able to ascertain in all the years that the process has been used under this company's jurisdiction.

Now that the United States promises to have one of the largest merchant marines in the world, and as practically all of the ships which have recently been constructed, and which will be constructed in the future, will be registered with the American Bureau of Shipping, the recognition of the thermit process by that Bureau bids fair to result in many important thermit marine welds from now on.

New Fitting-Out Wharf at Fore River

THE march of progress throughout the entire Fore River plant of the Bethlehem Shipbuilding Corporation at Quincy, Mass., has touched the water front and now the fitting-out dock built 18 years ago is being reconstructed. When the present dock was built in 1901 it was thought that the construction of concrete upon piling was strong enough to last a lifetime. The advent of heavier machinery proved this to be a fallacy and the constant strain of the enormous crane used in outfitting the ships has made it necessary to rebuild 180 feet of the dock.

When the firm of Holbrook, Cabot and Rollins, of New York and Boston, started the work of construction, it became necessary to use dynamite to break up the concrete that had been under water many years. The new wall will be built of granite blocks which will be placed in position when lowered to divers. The wall will be 180 feet long, 30 feet wide at the base and will taper toward the surface. The new dock will give berthing space for the largest vessels built at the plant as the water alongside will be dredged to a depth of 35 feet below low tide. It is expected that the dock will be finished by February, 1920.

Suggestions for the Profitable Operation of the American Merchant Marine

BY COMMANDER H. C. DINGER, U. S. N.

Basing his remarks upon close observation of the status of the United States merchant marine in world ports, Commander Dinger in this article offers constructive criticism on possible means for bringing about more profitable ship operations. He perhaps touches the crux of the problem when he bares our lack of co-ordinated national action in the shipping field. As a naval officer he recognizes the necessity of building up an organization composed of well-co-ordinated, functioning units which will operate under a supervising agency.—THE EDITOR.

THE United States has, through the circumstances of the War, suddenly acquired a large amount of shipping and is building a still larger amount. The shipbuilding and ship operating business from being a weak outcast has suddenly come into prominence. Shipping is vital to the industrial success of the United States in the markets of the world, as important to the country as communication is to business. Is the position of the United States in this field to be maintained?

By properly co-ordinating the elements concerned in shipping, by securing the highest industrial efficiency in all the activities relating to it, by providing the fostering care which the United States Government can and should give, and above all by securing the active support of public opinion, this vital industry can be so well established that it will become a mainstay to the resources of the country.

> We must produce more tonnage at a cheaper rate per ton. Unless employers and workers co-operate in accomplishing this, the industry will perish. If labor and capital will work together we can compete with the world.—*J. H. Rosseter, Director of the Division of Operations of the Shipping Board.*

To make a success of shipping, the Government must assist the industry, perform certain services which will facilitate its business, encourage its activities and remove such difficulties as may come within the sphere of governmental action. Handicaps and restrictions in the shape of bad laws or unjust imposts must be removed and particular advantages possessed by foreign competitors be compensated for in a proper and reasonable manner.

On the other hand, the private shipping industry must be built up on efficient and systematic lines so that it can operate economically and render adequate service to the industry of the nation.

As the shipping industry has grown up in the United States, the following organizations are the only American agents which are concerned in any public capacity with shipbuilding and ship operation.

(1) The American Bureau of Shipping.—This privately operated organization, like the British Lloyds, is substantially supported and directed by a mutual co-operative arrangement of American shipbuilders. It defines the rules of classification upon which marine insurance is given, makes the surveys and inspections which are the basis for this classification and in an advisory capacity examines and criticizes plans and specifications of ships about to be built to pass upon their availability for insurance. The British Lloyds performs a similar service. Both agencies promulgate safety rules applicable to the handling of ships and the control of personnel.

(2) The Steamboat Inspection Service.—This organization, which operates under the Department of Commerce, carries out inspections for the enforcement of safety rules for ships and their personnel. In addition, this department formulates rules for personnel on the vessels.

(3) The Bureau of Navigation.—This division of the Department of Commerce compiles records relating to shipping, shipping personnel and cargoes in a form which is useful to governmental agencies and to the shipping industry. In a passive way, that of historian chiefly, the bureau exercises general direction over shipping activities as these are related to development in other countries and to general trade conditions.

From this brief statement it will be evident that up to the time when the United States Shipping Board was esablished this country lacked organization mechanism, either public or private, which was empowered aggressively to boost shipbuilding or ship operation, or aid in the efficient development of the rudimentary tools at hand. A lack of co-ordination of the existing modus operandi further hampered progress.

Any constructive supervision over the shipping field should have included, for example:

(a) Investigation of the laws, rules and procedure affecting property and property rights of vessels, cargoes, freights, charts, etc., in American and foreign countries followed by the publishing of this information in condensed form for shippers and the formulation of amendments or new laws to be recommended for enforcement in those districts under the United States Government jurisdiction.

(b) General direction over shipping activities to aid and control in the development of this field in foreign countries and at home in connection with other trade conditions.

(c) Co-ordination of shipping activities with problems of national defense.

(d) Development of the most improved methods of construction and operation.

(e) Standardization of marine operating and administrative practice to secure savings in cost and operation and for simplifying operation and increasing capacity.

(f) General technical research and experiment for improvement of material. (In a way this research would serve as a basis for the development of the work considered in item d.)

(g) Distrtibution of (1) technical and (2) trade information which would be available as the result of active research work.

(h) Standardization of marine apparatus and equipment to improve production.

The Shipping Board is now functioning in many of these once untouched fields.

Through the Shipping Board and the Emergency Fleet Corporation—emergency agencies—the government has

been able to construct ships and undertake the establishment of United States steamship lines in places and under conditions where private capital would have hesitated to take the risks.

These organizations, however, are only the pioneers of a modern United States merchant marine. A government owned shipping company can never be the full answer to the shipping problem. The real merchant marine that is needed will be produced and developed by the initiative of private industry, properly assisted and directed by the Federal government in those fields where it can be particularly helpful.

Bureau of Maritime Commerce

To this end, the logical thing would appear to be to convert the Bureau of Navigation into a Bureau of Maritime Commerce, which should be as ambitious in its development as the Department of Agriculture or the Bureau of Mines. It would be the duty of this organization to give advice, information and, to a certain extent, assume supervision over shipping. This Bureau of Maritime Commerce should make a thorough examination of all laws affecting ship operation and recommend changes and additions which would place American ships on the seas without handicap. Should the Shipping Board be discontinued at the end of the "war emergency," this country would lack any organization which could act as a co-ordinating agency. In this case the Bureau of Maritime Commerce would have to assume active direction over shipping activities.

The Bureau of Navigation as now organized is not able to make technical researches or to take any part in initiating action which would bring about development or improvement of the shipping industry. The Steamboat Inspection Service, while responsible for the formulation of government safety rules regarding personnel and equipment, does not touch upon any phase of the development of the shipping trade. It would seem advisable, therefore, to have this service supplied by the privately operated American Bureau of Shipping in conjunction with technical engineering societies and technical bureaus of the Navy Department under the supervision of the Department of Commerce.

Right here we would suggest the possibility of coordinating the inspection service of the American Bureau of Shipping and the Steamboat Inspection Service. Some functions of the two organizations are similar. The requirements for insurance are more elaborate, however, than those for the safety rules; they are also more flexible, accommodating themselves more quickly to changes in technical practice. If, therefore, the American Bureau of Shipping were employed, on those vessels which they are inspecting for insurance, to make whatever additional inspection would be necessary to cover the safety rule requirements, the need for a complete duplication of these two inspection services would be obviated. This is a perfectly feasible project. The Navy Department for example, has employed the New York Chamber of Commerce fuel inspection service for a number of years with entire satisfaction and at an extremely reasonable cost.

But to return, the American Bureau of Shipping should be evolving standard specifications for ship and engine building practice, ship repair work, and for ship operation. Such investigation would serve as a basis upon which improvement could be effected in technical lines. If this agent were authorized by the Government to do technical research work in naval architecture and marine engineering, it could enlarge its technical department and by working with all other agencies engaged in similar work could serve as a centralizing medium in an organized, systematic effort to accomplish these ends.

It may not be amiss to mention some of the marine engineering problems about which the technical department of the American Bureau of Shipping could carry on investigations:

(1) The adjustment of commercial marine practice to the best foreign practice and to the requirements of naval practice for such vessels as may be used for naval purposes in case of war.

(2) Definition of good practice in construction and design based on naval practice, the requirements of Lloyds, British Board of Trade, Steamboat Inspection, etc., as a guide to shipbuilders and ship operators.

(3) Development of standard methods of construction, operation and marine engineering practice.

(4) Preparation and standardization of general specifications for hulls, machinery and for materials and devices entering into shipbuilding.

(5) The standardization of the shapes, dimensions, form and interchangeability of the following ship parts:

Hull fittings, shapes and plates; doors, ladders, hatches and coverings; anchors and anchor gear; boats and their hoisting gear; booms, masts and hoisting gear; riveting, framing and fastenings; boilers and boiler tubes; grates, furnaces and boiler fittings; oil fuel burning equipment; piping systems and pipe lengths; pipe fittings, flanges and valves; condenser tube sizes, gages and lengths; pumps and auxiliary machinery; electric wiring and wiring systems; instruments used on vessels; bolts, nuts, rivets, screws and other engineering fastenings.

A most valuable service would be the publication of a list of materials and devices that had been examined, tested and found satisfactory for marine service, indicating the particular uses for which they would be most suitable. This might obviate the use of unsuitable material and devices and thus secure better and more efficient ships and machinery.

(6) Determination of devices and processes of manufacture thought to be desirable for development and experimentation. Lists of such devices might be published from time to time.

(7) Research in such matters as improvement in quality of materials, preventatives of corrosion, causes of failures in materials such as crank shafts, boiler tubes, condenser tubes, cylinders of oil engines, etc.

Factors of Economical Ship Operation

But to turn specifically to the question of economical ship operation, the following points demand consideration:

(a) The first cost of ships.

(b) Operating conditions, including the routing of ships and provision for adequate cargo facilities.

(c) Marine insurance.

(d) Cost of operating vessels.

As the shipping business is now handled, cargoes are secured for ships and ships for cargoes through ships' brokers. As a rule no one broker controls enough cargo space to really give first class service to the shipper. A large ship brokerage organization with well established agencies and with a large tonnage at its disposal could bring about an immense reduction in the cost of handling miscellaneous cargoes and could also increase the cargo-miles of the ships under its jurisdiction. By establishing a United States overseas ship brokerage association under the regulation of the United States Government and assigning to it all Shipping Board vessels and any private vessels which might desire to avail themselves of the service one great step would be taken in securing better economy in operating our merchant marine.

To provide proper terminal facilities in foreign ports where our vessels are to trade, a large corporation should be organized to be operated under government supervision and regulation. This company should erect terminal facilities in foreign ports where such facilities would be required for our shipping. Such a corporation might be organized in connection with the Shipping Board. Just as the Emergency Fleet Corporation has been provided to build ships, the Port Corporation could be organized to build and operate terminal facilities.—Commander H. C. Dinger, U. S. N.

(e) General business conditions, laws and practices governing operation of shipping.

The cost per ship must be brought down to a figure which compares favorably with the cost for a ship with equal equipment in foreign lands. Already a large portion of the shipbuilding materials can be made in the United States as cheaply as elsewhere. The amount of material needed and the cost of its fabrication can be reduced very materially by efficient standardization, not so much of the ships themselves, but of the parts and equipment which go into the ship.

If we learn to build ships in quantity, as we do automobiles or agricultural machinery, for instance, we can build good serviceable ships much more cheaply than we have been building them. Moreover, to use a developed standard design, well tried out, will be better than to design anew each time. Then, to lower the price, we must build on a large scale, put shipbuilding on a manufacturing basis. This is where an immense plant like Hog Island will eventually prove its advantage. Though perhaps the first cost of this plant may be enormous, and its building may have been wasteful, when once it gets its stride and is well organized and outfitted with competent workmen, it will be able to build vessels very cheaply in spite of the high initial cost of the plant.

The rules of the classification society under which the building is done may materially add to or lower the cost. In this field the American classification societies can give valuable assistance in arranging their rules to permit and to encourage economical production, while continuing to provide for safety.

The labor charge at the shipyard and engine plant represents nearly fifty percent of the cost of a vessel. This can be reduced, of course, by using labor saving devices and by standardization of parts and of methods. But a still more potent factor lies in the skill and capacity of the workmen. This is largely a matter of training and of keeping workmen at a particular line of work to make them expert. The excessive labor turnover in the United States machine shops and shipbuilding yards results in a serious loss to all concerned and makes the ships cost more. The War Labor Board has brought about a rise in wages, but it has not added to labor's efficiency. Labor should be paid in proportion to the skill required and the output produced. Any other basis is illogical and likely to be extravagant. If poor, indifferent and careless workmen are to receive the same compensation as those who produce excellent results, efficiency will surely suffer. At present, the highly skilled and reliable worker receives too little, while the unskilled, lazy and indifferent man receives too much. If labor costs of shipbuilding are not put upon a basis where the United States can compete with the foreign shipbuilder, the excess cost will have to be made up by the public in some other way or we will cease to build ships except for local service.

General Operating Conditions—Need of Cooperation

Much of the handicap which makes the operating cost of United States vessels high can be made up by more efficient routing and despatching of vessels and more intelligent preparation of cargoes so that the stay of vessels in port, awaiting loading and unloading, is lessened and the cargo-miles per year increased. A study of the cargo to be moved, its location, and the ships available would enable the routing to be made much more intelligently. Some governmental agency such as the Department of Commerce or the Shipping Board could do yeoman work along these lines which would greatly add to the efficiency of the United States vessels, so that the maximum of freight might be moved with the minimum of ships. It is inefficient to operate competing lines in fields where one line can more than handle the actual business. On the other hand, if in certain regions there is a deficiency of freight, a study of the whole situation should be made to see if additional cargo can not be made available. Such a general study can be made by a governmental agency, supplemented by the various shipowning companies and associations. It will, of course, be advantageous to have the ship operating organizations control a considerable number of vessels. For this reason large shipping companies should be encouraged or combinations formed of several small companies for the purpose of routing and assigning cargoes. In any case there should be the very greatest cooperation between American ship operating companies; all competition should be with foreigners rather than with American ship operators.

If this line of endeavor is consistently carried out by the Federal government, by the public and by the shipowners and shippers, it will be possible for United States shipping to do our carrying trade as cheaply or more cheaply than the foreigner can. But, if these different activities become antagonistic to each other and work against each other, the foreign shipowner will profit.

Since it costs nearly as much to keep a cargo vessel in port as it does to have her moving at sea, the advantage of reducing this stay in port to the irreducible minimum may be appreciated. Terminal facilities are the controlling factor here. This applies particularly to loading facilities, but unloading facilities for special bulk cargo are equally important.

The problem should be considered from a national standpoint. Each port should be made adequate for the freight and cargo that should be allotted to it in the general scheme. If this is done, we will have the most efficient facilities at the least cost to the whole country which will mean the lowest practical carrying charges. Antagonistic competition between ports profits the foreigner only. An increase in our foreign trade will make more work for all of the ports, each receiving profits in proportion to the service it renders in the general scheme.

The responsibility for providing and regulating port facilities should be under state jurisdiction, in some cases under municipal jurisdiction. Private enterprise cannot develop a large harbor in any systematic manner. The general planning and a large part of the actual building of wharves, storage houses and handling facilities should be carried out by the state and subsequently made available for public use at a price which will cover the cost of service.

To provide proper terminal facilities in foreign ports where our vessels are to trade, a large corporation should be organized to be operated under government supervision and regulation. This company should erect terminal facilities in foreign ports where such facilities would be required for our shipping. In certain ports, such an agency might not be allowed to build and operate, but in many other locations where facilities are badly needed, authority could no doubt be obtained. Such a corporation might be organized in connection with the Shipping Board. Just as the Emergency Fleet Corporation has been provided to build ships, the Port Corporation could be organized to build and operate terminal facilities.

With terminals comes the question of proper storage facilities at ports to prevent loss and damage to perishable cargo; also the question of providing bonded warehouses or free ports. The Panama Canal Zone, St. Thomas, Key West, Honolulu, and other places might be made

free ports to attract shipping business for interchange of cargo.

Marine Insurance

The subject of marine insurance is, of course, a field in itself. Practically all marine insurance up to the beginning of the late war was handled by foreign companies, mainly British and German.* United States shipping was paying toll to foreign enterprise. We certainly should insure our own ships and, under government supervision, this could be handled at lower rates. If we operate our own insurance, we can make the rules as favorable as possible to United States vessels and industries, thus reducing the actual expense of the insurance.

The American Bureau of Shipping under government supervision and backing offers a convenient method of providing for American marine insurance classification. As a semi-commercial institution the shipowning and shipbuilding representatives can keep its methods up to date and see that the insurance requirements are such as to give the best service to the trade in general.

Reducing the Cost of Operation of Ships

In considering the cost of operating vessels per cargo mile the main factors are (1) efficiency and reliability of officers and crews, (2) consumption of fuel and supplies and their cost, (3) economy, state of repair and material upkeep of vessels, and (4) speed with which reliable repairs, docking and overhauling can be accomplished.

> The United States cannot hold its own in competition with other nations unless additional facilities are created abroad by private enterprise, especially by the shipping companies. Little has been done in this direction as yet because of uncertainty on the attitude of the Government.—*J. H. Rosseter, Director of the Division of Operations of the Shipping Board.*

Practical requirements should be made the basis for the licensing of officers and manning of vessels. An efficient system for training and developing officers and men for the merchant service is also of the greatest importance. In these lines the Federal government can greatly assist. Methods of scientific management and welfare must be applied to the personnel operating the vessels. Efficient bonus or profit sharing systems will reduce the actual cost of operating ships. Such systems are now employed to a considerable extent on fishing vessels, but have not yet been applied to freight and passenger carrying vessels. Obligatory pension systems and sickness and disability benefits will add much to the efficiency of the personnel and enable the shipping business to secure more intelligent and hence more efficient labor.

Each ship operating company should know the supplies needed for its ships, and the products which are most suitable to fill these needs. A general purchasing agent should purchase these supplies in large quantities. Ships might be placed on a money allowance, as is now the custom in the Navy. Competitions between different vessels for performance and economy in operation, with bonuses for saving, would, no doubt, improve results, saving money to the company as well as providing more remuneration to the crews and indirectly lowering rates. The cost of fuel is largely a matter of where it is purchased; its economical use is dependent upon the efficiency of the machinery and of the operating force. The intelligence and capability of the operating force is the vital factor, since it may easily double the amount used. As this cost may easily be several times the amount of the men's wages, it may be an advantage to pay high wages if thereby fuel is saved.

A careful supervision over the use of material and the establishment of proper standards or allowances, together with thorough investigation and accountability for all cases of waste will reduce the expenditure for supplies to a proper basis.

Economy and State of Repair and Upkeep

If a vessel is kept in perfect condition by its crew it can be operated more economically and will also require fewer repairs, and, what is very important, will require less time in being laid up for repairs. To secure satisfactory conditions, efficient supervision and inspection of all vessels is required. Information as to the best methods of operation and maintenance must be distributed among the crews and put into practice. This will not be done if each vessel is permitted to work out its own salvation. By having a scientific, technical staff, however, to supervise and direct and to co-ordinate the personnel of the different ships that may belong to any one organization, excellent results may be obtained. Each shipping company should systematize the training and instruction that is given to the operating personnel and see that good practice is uniformly carried out.

Speed and Economy in Making Repairs

If the ship's force is encouraged to make its own repairs and is given the facilities for doing this, much shop and dock yard work may be avoided. An extra mechanic or two and a few machine tools placed on board the ship will more than save their cost. A periodic overhaul after careful inspection by the supervising engineer will also reduce the final repair bill and guarantee reliable operation. Repairs at small and inadequate shops in remote foreign ports and in places where facilities are lacking are very expensive, hence care should be exercised that this work is done at home ports, in well equipped shops where repairs can be adequately accomplished. Previous to the war, foreign vessels did not have repair work done in the United States if they could possibly avoid it on account of inadequate facilities and high costs then current. The recent development of American repair facilities has eliminated this cause of complaint against American ports.

Other Conditions Which Relate to the Ship Operating Field

Petty graft adds materially to the cost of operating vessels. As commonly practiced, the masters and engineers get a 10 or 20 percent commission on charges made to the ship for stores, fuel, repairs, tug hire, etc. This is a common practice, but a thoroughly vicious and indefensible one. The only excuse for it, a poor one, is that the wages paid are so low that the graft fees are a justifiable increase to the pay of the captain and chief engineer. The pay received by ships' officers should, of course, be adequate. A bonus system for saving and efficient operation is the remedy, but the gleanings should go down to the subordinate officers and crew as well. We have long since abolished prize money in the Navy and it is time that the commission graft in the United States merchant marine be consigned to limbo.

Again, there are too many middle men in the management of sea going freights and the control of the ship's expenses. These middle men toil not, neither do they spin, but they reap what should go toward lowering freight rates and providing better wages and living conditions for the crews of the vessels.

*Editor's Note:—See summary of present insurance conditions contained in article appearing in this issue.

Seafaring labor must be brought into proper co-operation with the shipping industry. In various places there has not been present a proper co-operation between the more radical element among the labor leaders and the shipowners. Where the labor leaders have demanded impractical, wasteful and expensive conditions, which, while adding greatly to the expense of operating ships, did not improve the ships, the living conditions of the operators, or the efficiency and economy with which ships can be operated, they have been a handicap. Where they have aimed to conserve the just rights of the worker and secure fair treatment and proper living conditions, they have helped. Restrictions which limit production so that an operator is not allowed to repair his own machinery or work more than eight hours a day, no matter what the emergency, and demands for entirely unnecessary personnel cannot be defended and merely give the foreign ship an advantage. On the other hand, the shipping industry must realize that the day of the shipping agent and the bucko-mate are past. The seafaring workers have rights and even some privileges and improved conditions and treatment will naturally produce more efficient and more loyal crews.

The Part of Labor in Economical Operation

If the organizers of seafaring labor will advocate efficiency and economy, they can do a very great service. When such an attitude is assumed, it is likely that shipowners will meet them half way by improving conditions so that a high standard of living and of efficiency may be maintained on United States merchant vessels. The present differences between the leaders of seafaring labor unions and shipping operators are a serious handicap to the efficiency of the United States merchant marine. These must be overcome before the United States can successfully meet foreign competition. Our ships are a national matter, in which our industry and the general public are deeply interested and concerned, consequently when the real facts are known, needed relief from the attempted restrictions of the more radical labor leaders may be secured.

Centralizing Ship Brokerage

As the shipping business is now handled, cargoes are secured for ships and ships for cargoes through ships' brokers. As a general rule there are altogether too many brokers, consequently no one broker controls enough cargo space to really give first class service to the shipper. We need a large ship broker organization with agencies in all the principal ports. This organization should have under its jurisdiction the cargo space of practically all of the United States shipping offered for service. The present system is as if 500 separate telegraph and postal companies were operating in the United States and every time a business man wished to send a telegram he would first have to go around and find which one of the companies could handle it. The small shipper loses out and has to hire a broker who often charges exorbitantly for his services. A large ship brokerage organization with well established agencies and with a large tonnage at its disposal could bring about an immense reduction in the cost of handling miscellaneous cargoes and could also increase the cargo miles of the ships under its jurisdiction. By establishing a United States overseas ship brokerage association under the regulation of the United States Government and assigning to it all Shipping Board vessels and any private vessels that might desire to avail themselves of the service one great step would be taken in securing better economy in operating our merchant marine.

Under this arrangement anyone having freight to handle would apply to the agency, just as one now does to the railway express. Any vessel having available cargo space would also apply; thus the shipper and the ship would be brought together at little expense to either and the freight would be handled more cheaply, while the vessel would be earning more because its cargo-miles would be increased.

There are now several large forwarding companies, such as W. R. Grace & Company or Gaston, Williams and Wigmore, who serve the shipper in this way. But none of these agents controls enough cargo space to give efficient general service to the small shipper who desires to ship to various foreign ports. In other wards, we must provide offices centrally controlled for our United States world delivery system. In foreign ports it is important that we have a United States office to handle that end of the delivery as well. At present our shipping business is handled largely by foreigners both in foreign ports and in the ports of the United States.

Removal of Legal Restrictions on Trade

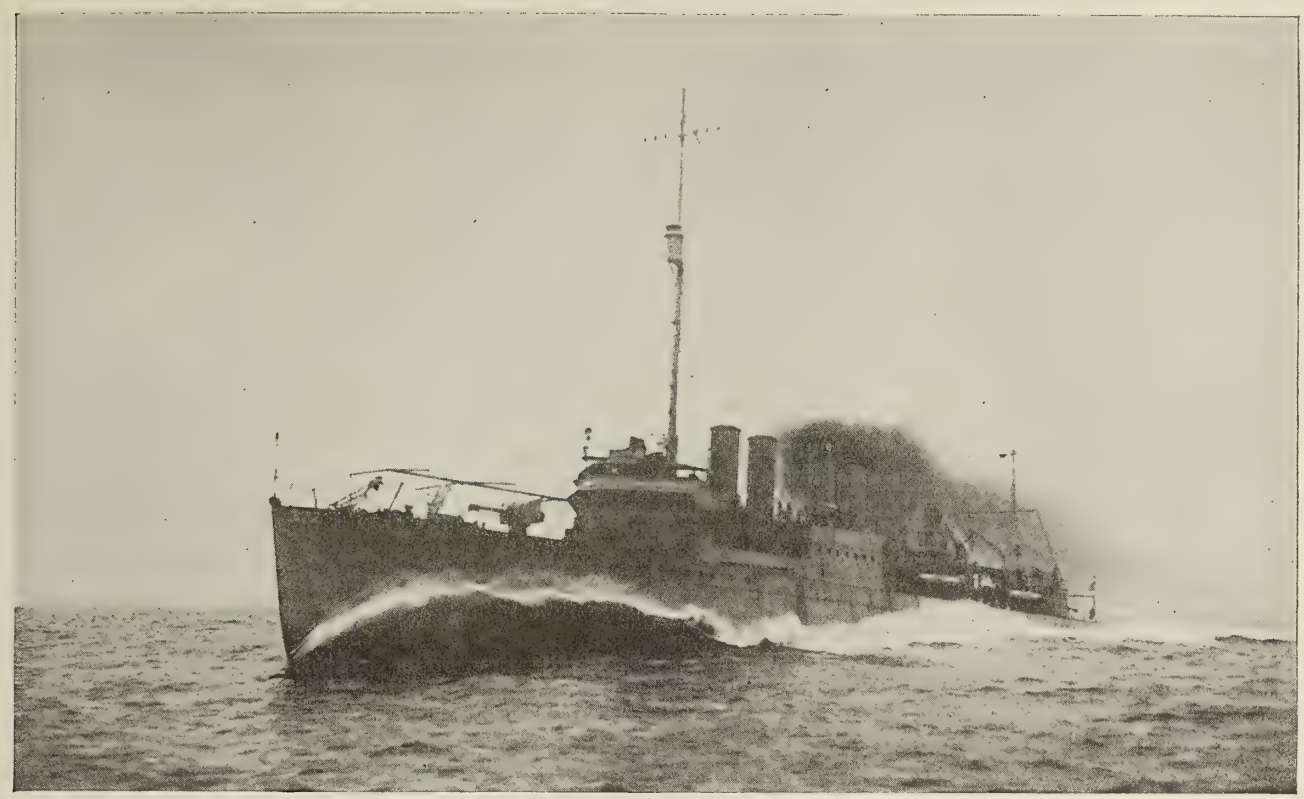
I need not mention that the LaFollette seamen's act and certain navigation laws greatly hamper the development of the United States merchant marine. The so-called Webb law has been designed to correct defects in certain anti-trust laws as these relate to foreign trade activities. Steps should also be taken to have the LaFollette law modified along national, sensible and patriotic lines. Our navigation laws, though they have been changed for the better during the war, need further revision.

There should be provided some recognized impartial and expert authority in the Department of Commerce to whom all proposed laws effecting the shipping industry could be referred for comment and recommendation before they are acted upon by Congress. If this were done the shipping industry would have some properly appointed and authoritative champion who could be on the lookout for its interests.

Finally, when we have adjusted shipbuilding and ship operation upon an efficient and scientific basis, we may find that due to special conditions (mainly much lower labor costs) the foreigner can still operate his vessels more cheaply than we can. This condition would indicate the need of some further public assistance to the shipping industry—the giving of preferential duties to imports in United States bottoms and the fixing of lower port charges for vessels flying the United States flag. This is, of course, an indirect subsidy, but it is fully justified. The whole country is interested and needs an American merchant marine not only for commercial but also for military reason; hence, the whole country and particularly the industry of the country that is served and protected by this merchant marine must needs contribute something for its support.

Conclusion

In this article an attempt has been made to point out several practical points that vitally affect the economical operation of United States shipping. The control of some of these matters may be invading the vested rights of long established custom. The United States cannot, however, get something for nothing. We cannot have a United States merchant marine simply by wishing for it, or by having the Emergency Fleet Corporation give contracts for a lot of ships, or by publishing lists of these contracts and estimates of how much shipping we hope to have by 1925, etc.



United States Destroyer "Reid" on Her Trial Trip

A World's Record in Shipbuilding

Squantum Works of the Bethlehem Shipbuilding Corporation, Ltd., Builds Destroyer in 45 Working Days

AT THE time this country entered the war, the Government found itself extremely short of that most essential type of naval vessel, the destroyer. The necessity for these boats was so forcibly shown by the experiences of our navy abroad that the secretary of the navy awarded to the Bethlehem Shipbuilding Corporation, Ltd., what is said to be the largest contract ever given out in the history of the world. This contract covered the construction of ninety-one destroyers and the building of a complete new plant for manufacturing them. Twenty-five of these destroyers were given to the Union plant of the Bethlehem Shipbuilding Corporation, Ltd., at San Francisco, and, of the balance, thirty-six were allocated to the Quincy works of the Fore River plant of Quincy, Mass., and the remaining thirty-five to the proposed new shipyard at Squantum known as the Squantum works of the Fore River plant. This undertaking made it necessary to construct, in addition to the shipyard itself, a turbine shop at Buffalo, known as the Black Rock works, and a boiler shop at Providence, R. I., known as the Field's Point works. These two works, together with the Quincy and Squantum works, comprise the Fore River plant under the management of S. J. Wakeman. The work was thus distributed between three industrial centers, so as to leave the labor market undisturbed at Quincy.

Ship Production at the Squantum Works

On September 7, 1917, ground was broken for the new shipyard at Squantum. The site chosen was a tract consisting of 366 acres of bleak marsh land, owned formerly by the New York, New Haven and Hartford Railroad. The following winter, the most severe in years, will always be remembered by those first men at Squantum. The plant was constructed in the face of inconceivable difficulties, and the first months of shipbuilding brought even more trying conditions. But the men were not to be discouraged. Gradually the wheels turned faster and the work progressed more smoothly. The following November, scarcely a year after the ground was broken in the construction of the plant, the first ship was delivered to the navy. October of this year, therefore, marked the second anniversary of the plant which had at that time a record of twenty-two deliveries, twenty-nine launchings, and keels for the entire contract laid. The rate of production which has at the present time been attained by the Squantum works is shown by the record of five deliveries and two launchings during July, and four deliveries and six launchings during the month of September.

Building a Destroyer in 45 Working Days

Not content with these records, the Squantum works has established a world record by building the destroyer *Reid* in 45 working days—a reduction from the previous record of 174 days held by the same plant at the Quincy works. At the time the U. S. S. *Reid* was laid down, sixteen other ships were building. From September 9 when her keel was laid until November 6, when she was delivered, five other destroyers were launched and six delivered. The *Reid* was the first November delivery from Squantum. But before the month was over three more deliveries were added, and during December three additional boats will be turned over to the Navy Depart-

ment. This ship went through exactly the same procedure as every other destroyer built for and accepted by the Navy Department. She passed the regulation tests and inspections and underwent the same trials and post-trial examinations. If the inspectors made any exception in the case of the *Reid,* it was to make their inspections more rigid. So the *Reid* stands, not as a freak built under special conditions, but a well-tried ship, complete in every detail and ready for immediate service.

Representing the most modern type of destroyer as developed during the war, the *Reid* is 310 feet long between perpendiculars, with a molded beam of 30 feet 11½ inches, and a molded depth of 20 feet 8 inches. Her trial draft is 9 feet 5 inches and her trial displacement 1,215 tons. She is equipped with four oil-burning boilers of the Yarrow "express" type, operated under the closed fireroom system of forced draft and supplying steam at 265 pounds pressure. Her oil tanks store enough fuel to give her a cruising radius of more than 4,000 nautical miles. Propulsion is by Curtis turbines developing 27,500 horsepower, driving the ship through reduction gears at a maximum speed of 35 knots. The ship's armament consists of four 4-inch guns, one anti-aircraft gun, and four 21-inch triple torpedo tubes. The *Reid* also has provisions for installing the "Y" gun and stern-releasing gear for scattering the depth charges which proved so disastrous to German submarines. When commissioned, the *Reid* will have a complement of six officers and 96 men and will be detailed to the Pacific Coast.

How the World's Record Was Made

The keel of the *Reid* was laid on September 9 at 7 a.m. Before the first day's work was finished, five bulkheads were erected, the reserve feed tank was assembled complete, the boiler room tank sides were in place and the erection of frame and shell plating had already commenced. By the end of the second day, the keel was practically laid, the stern, the bow section, the stern frame and practically all frames and bulkheads were erected. On the fifth day the pipe fitters started fitting fuel oil lines to the forward tanks and three days later the sheet metal workers and electricians were at work on the ship. By October 1, 17½ working days from the start, the hull, with the exception of a few deck and shell plates, was completely erected. Meanwhile riveting was progressing at a rapid pace. On this same day, the machinists started work on the sea chests and the sheet metal workers began the installation of corrugated bulkheads in the officers' quarters. Three days later, on October 4, the hull department started the first water test, filling the reserve feed tank. The pipe fitting was proceeding rapidly and the electricians were welding hangers and clips all over the ship. The machinists had burned out the sea chests and air ports and had already started the installation of auxiliary machinery. During the next few days the water tests proceeded. The riveting was rapidly cleaned up, the rudder line passed and the rudder installed. On Saturday, October 11, the shaft line was run and the boring completed. The shafting and propeller were installed the first of the following week. On October 14 the hull department finished all water tests and began air testing.

The following day, October 15, the vessel was launched at 4:30 p.m. At the time of launching the boat was completely water tested and several air tests were already passed. The foundations were complete and the forward and aft deckhouses erected. All auxiliaries were installed except three units, which could not be put in the ship until after launching. The trunks for the forced draft blowers had been fitted and the scuppers and propeller guards finished. A good start had already been made on the shelving in the storerooms and magazines and most of the main pipe lines had been fitted. The electricians had completed over half of the layout work and the pulling of cables had already begun.

Fitting Out and Testing the Ship

After the launching, the work moved, if possible, more rapidly than before. The hull department erectors had already begun taking off the deck before the boat was docked. By 7 p.m. the deck was stripped and the installation of boilers started. At 2 a.m. the following morning the first condenser was installed and by 12 noon all machinery was located permanently in the ship. On the morning of October 17, two days after launching, the galley was erected in one unit. It was immediately followed by the erection of the four stacks. The same morning bricking was started on the boiler furnaces and the first fitting was made on the main exhaust trunks. On October 18 the shafting was passed for alinement and the first boiler hydrostatically tested. The boiler room tanks were filled with oil and the 24-hour oil test began the following Monday. The first steam test was passed on October 21 and, on the same day, the art metal furniture was started in the staterooms and the metal sheathing in the crew's quarters. On Thursday, the 23rd, the first linoleum was laid in the petty officers' quarters and on the same afternoon both masts were stepped. Steam was put on the ship Friday and current was operated for the first time. The spinning test and dock trial were successfully completed on Monday, October 27. The following day the builders' trial was run with an average of 454 revolutions. Three days later, October 31, the ship successfully ran her official trial and was accepted by the trial board. On the following Thursday, November 6, having completed her post-trial examination, the U. S. S. *Reid* was delivered to Charlestown Navy Yard with appropriate ceremonies.

Individual Records

There are many interesting figures in connection with the building of the *Reid.* Over 200 tests and inspections, in addition to tank tests, had to be passed during the construction of the ship. Some idea of the speed of production can be obtained by considering that twenty-two tests were passed in one day. In running the shaft line, boring and installing the shaft and propellers, all previous records were shattered when the whole was accomplished in less than 24 hours. The entire ship, consisting of 51 compartments, was water-tested in nine working days and passed her boiler room tank for final inspection two days after launching. All of the main machinery was installed in eight hours. The furnace pans were ready for bricking on the second day after launching and bricking was finished on the fourth day. Targets were taken for all of the main steam expansion bends and the pipes installed in three and one-half days. Ninety percent of the pipe covering throughout the ship was completed in five nights' work. The greatest rivet drive for a single week was 160,000 rivets and an average of sixty-six rivets per gang hour was maintained up to launching.

All of this work was accomplished without any overtime work and without any night work except those details which could not be conveniently done on the regular shift.

Some New Developments in Diesel Engine Construction in the United Kingdom

BY OUR SPECIAL LONDON CORRESPONDENT

NEVER previously has such interest been taken in Great Britain in the problem of construction of motorships as at the present time, and while this is to a certain extent due to the extremely high price of coal and to Lord Fisher's campaign in favor of internal combustion engined warships and mercantile vessels, it is essentially an outcome of the normal process of evolution. There are now very few marine engineers and shipbuilders in the country who are not convinced that the future lies with the motorship, and while they are one and all continuing with the construction of steamships and steam driven machinery as an immediate necessity, the majority are laying plans for the future building of large motor vessels as standard types.

The most interesting feature of this development from the standpoint of the marine engineer is perhaps that almost every firm of note is producing its own special Diesel engine, differing radically from all other types, and, to name only a few, Vickers, Armstrong, Doxford, Scott, Cammel Laird, Swan, Hunter and Wigham Richardson, and Harland & Wolff, are all building motors of their own designs, although in one or two instances they are based upon Continental engines. About half of the engines are of the two-cycle and half of the four-cycle type, while a noteworthy feature is that at least one concern is developing both, with a view to adopting the latter in moderate powered ships, and the former for much larger vessels.

A New Double-Acting Diesel Engine

An example of this is afforded by the North British Diesel Engine Works, established on the Clyde, whose factory has been laid out for the construction of marine oil engines up to 12,000 brake horsepower in six cylinders. They are now manufacturing four-cycle motors of 1,800 brake horsepower, in addition to which they are laying plans for the construction of two-cycle double-acting motors, of an entirely new design. This is all the more interesting in view of the fact that the works were originally erected for the production of Diesel engines of the Krupp type, including the double-acting machine made by the German firms. This has now been abandoned and the new motor will be on entirely different lines.

Its main feature lies in the method employed for scavenging and in discharging the exhaust gases, while the system of fuel injection at the bottom of the cylinder—always a difficult problem in double-acting engines—is quite novel. In the center of the cylinder are two sets of ports opposite to each other, one set for the exhaust and one for the admission of the scavenging air, each occupying a total of about one-third of the periphery. Each set of ports leads into a chamber in which is a piston valve operated from a cam shaft through the necessary levers. On the downward stroke of the piston the valves remain closed until the correct time for exhausting, when the valve controlling the exhaust ports is opened, followed by that regulating the entry of the scavenging air, which thus drives out all the spent gases and fills the cylinder with pure air, ready for the compression stroke. The valves are then closed and the action is repeated on the upward stroke of the piston, and it may be noted that with this design the piston can be relatively short.

In order to avoid the uneven combustion and the consequent unequal distribution of the pressure over the bottom of the piston, due to the obstruction to the fuel jet caused by the piston rod, double-acting Diesel engines have usually been built with two fuel valves in the bottom cover. The North British Diesel Engine Works' design overcomes this difficulty by forming a recess in the bottom of the piston itself, this recess acting as a combustion chamber, while the piston is shaped as closely as possibly to the cylinder cover with very little clearance. The recess is made by having a ribbed conical enlargement at the top of the piston rod, the enlargement being fixed to the bottom of the piston. The fuel is injected through the space between the ribs and is thus directed right into the combustion chamber without its passage being impeded in any way. By this means it is claimed that very efficient combustion and equally distributed temperature and pressure are attained. The piston is, of course, water-cooled, and the whole design appears to be well adapted for engines of very large power. The development is of particular interest at the moment, as suggestions are on foot for building some large passenger motor-liners.

13,000-Ton Motorships

The first of the four 13,000-ton deadweight motorships for the Glen Line will shortly be completed by Harland & Wolff and it is not unlikely that still larger vessels will be laid down, while a vessel of similar size will be put into commission before the end of this year by the East Asiatic Company, built by Burmeister & Wain at Copenhagen, who have now sufficient motorships on order to keep them busy until 1927. In the Glen liner two 3,200 indicated horsepower eight-cylinder engines are installed and the now standardized practice of driving all the auxiliaries by electricity will be followed, as this has been found more economical and convenient than the installation of a boiler and the use of steam winches, steering gear, etc.

A 3,000-Horsepower Four-Cylinder Engine

The 3,200 indicated horsepower engine represents an output of 400 indicated horsepower per cylinder, but in view of the discussion concerning the maximum power per cylinder which can be developed in a Diesel engine the 3,000 indicated horsepower motor which will shortly be completed by Wm. Doxford & Sons for a 10,000-ton single-screw cargo ship is still more interesting. This engine has only four cylinders, 750 indicated horsepower per cylinder, and is by far the largest example of the opposed piston or Junkers type that has yet been built, although Doxfords have had an experimental cylinder of almost equal power, running for some years. It is really a low compression engine with a compression pressure of 360 pounds per square inch instead of the usual 480-500 pounds per square inch. This favorable condition is achieved by maintaining the top of the piston at high temperature during the cycle, so that the temperature of the compressed air, and therefore its pressure, may be much lower than in Diesel engines of orginary design.

The Doxford motor has other unusual features, one of which is that solid injection of fuel is used, and another that it runs at the low speed of 77 revolutions per minute, which is eminently suitable for a cargo ship. The experimental engine has operated for several days continuously at 25 revolutions per minute, which indicates the wonderful degree of flexibility possible with this type of motor.

Electric Propulsion of Merchant Ships

Results Obtained With Electrically Propelled Ships—Advantages Claimed and Comparison With Geared Turbine and Reciprocating Engine Drive

BY W. L. R. EMMETT

THE use of electricity for propelling ships was first advocated in the case of large warships in which it affords particular advantages in the matter of cruising economy through change of speed ratio, interchangeability, space distribution, etc. The first application, however, was made in the case of the United States collier *Jupiter,* which is in most features a ship of the merchant type. The demonstration of geared-turbine propulsion came after the first serious proposals of electric drive, and the advantages which have been attributed to the geared method have suspended such activities as were considered in this country in the direction of electric drive for merchant ships, while, in the case of warships, electric drive activities have been uninterrupted. In the meantime certain electrically driven ships built in Europe, operated with very high degrees of superheat, have shown wonderful fuel economy, and many more such ships are being equipped.

The larger American shipbuilders, having their own facilities for machinery construction, have, not unnaturally, been opponents of electric drive, and the Emergency Fleet Corporation, which for some time has represented ownership, has for various reasons discontinued such activities in this direction as had been planned.

Two or three years ago the writer was of the belief that the geared equipments then being made afforded a solution of the problem which in cost and results would probably prevent commercial success of electric drive in merchant ships, although it was realized that the margin of possible advantage was small. Since that time improvements in electrical designs have been developed, and limitations of gear possibilities have appeared which put the question in a different light, and it is now the writer's belief that electric drive is justified in all large ships and that it will very soon develop a wide application, notwithstanding the great efforts of skill, organization, and capital which have been given to the introduction of the gear drive for vessels of all classes.

The discussion of this subject is largely a matter of comparison with other methods, and the purpose of this paper is to make clear what is proposed in a specific case and to suggest comparisons which may affect relative value.

The case selected is that of a vessel of 8,800 deadweight tons, length 424 feet, beam 54 feet, having a cubic capacity of 460,000 cubic feet and capable of making 11.5 knots with 2,500 shaft horsepower delivered to a propeller operating at 100 revolutions per minute. Fig. 1 shows an electric propelling equipment applied to such a ship, and, for comparison, an equipment with triple-expansion engines is shown in Fig. 2. It will be observed that in this design the motor is placed as far aft as convenient, affording space for disassembling and for removal of the tail shaft. The generating unit and controlling equipment are placed near the boilers in such a manner as to afford a maximum convenient saving of cargo space, the condenser being suspended below the turbine in the same compartment with boilers. The auxiliaries are distributed in convenient locations in the turbine room and in the space below near the condenser.

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November 14, 1919.

The weight of this equipment, including generating unit, motor, controlling mechanism, and direct current exciter, will be about 67 tons.

Auxiliaries

In connection with such equipments it is proposed to use, as much as possible, electrically driven auxiliaries. It is necessary to maintain an electrical supply independent of the main generator for purposes of excitation and lighting. The losses involved in the operation of larger auxiliary generating equipment are relatively much less, and there is no increase of complications. With such an equipment it is proposed to install two 150 kilowatt, turbine-driven, direct-current auxiliary generating units, one being required for service and the other installed as a spare. Excitation and lighting will only amount to 40 kilowatts, leaving 110 kilowatts available for any possible auxiliary uses. A little more than half of this should be sufficient for normal conditions. While the ship is at sea, for reasons of simplification and economy, it is proposed to exhaust the auxiliary generating unit into one of the lower stages of the main turbine at a pressure somewhat above the atmosphere, so that some of this exhaust steam will be available for feed heating if that obtained from steam-driven auxiliaries is insufficient. In port these auxiliary units would be exhausted into an auxiliary condensing plant which would be idle while the ship was at sea.

Motor Compartment

The motor carries the thrust bearing and is also equipped with a simple, slow-moving oil pump which maintains automatic lubrication in the motor compartment. This lubrication can be arranged with a storage tank and with an emergency drip supply to the low-speed bearings contained in the after compartment, so that, even if the oil pump should fail, many hours might elapse before injury could result to any of the bearings. With such an arrangement the self-lubrication of this compartment becomes entirely simple and safe, and with occasional inspection it should be operated without an attendant and without any passage connecting it with the engine-room; in fact, there is nothing that an attendant can do in this compartment, and there would be quite as much reason for keeping an attendant on the truck of an electric locomotive where the electrical and lubricating conditions are far more complicated.

Space Saving

It will be observed that the omission of the shaft alley and the diminution of space required for the engine room materially increases the cargo space and simplifies its shape. This increase amounts to something over 12,000 cubic feet, nearly 3 percent of the total capacity of the ship. The omission of the shaft alley, shafting, and supporting bearings effects a weight saving of about 60 tons, and there will be an additional weight saving in the machinery itself since the electrical equipment will weigh about 9 tons less than the engine equipment for such a ship.

Economy

If this equipment is operated with 200 pounds steam pressure, 200 degrees F. superheat, and a vacuum of 28.5 inches, the steam consumption per shaft horsepower hour,

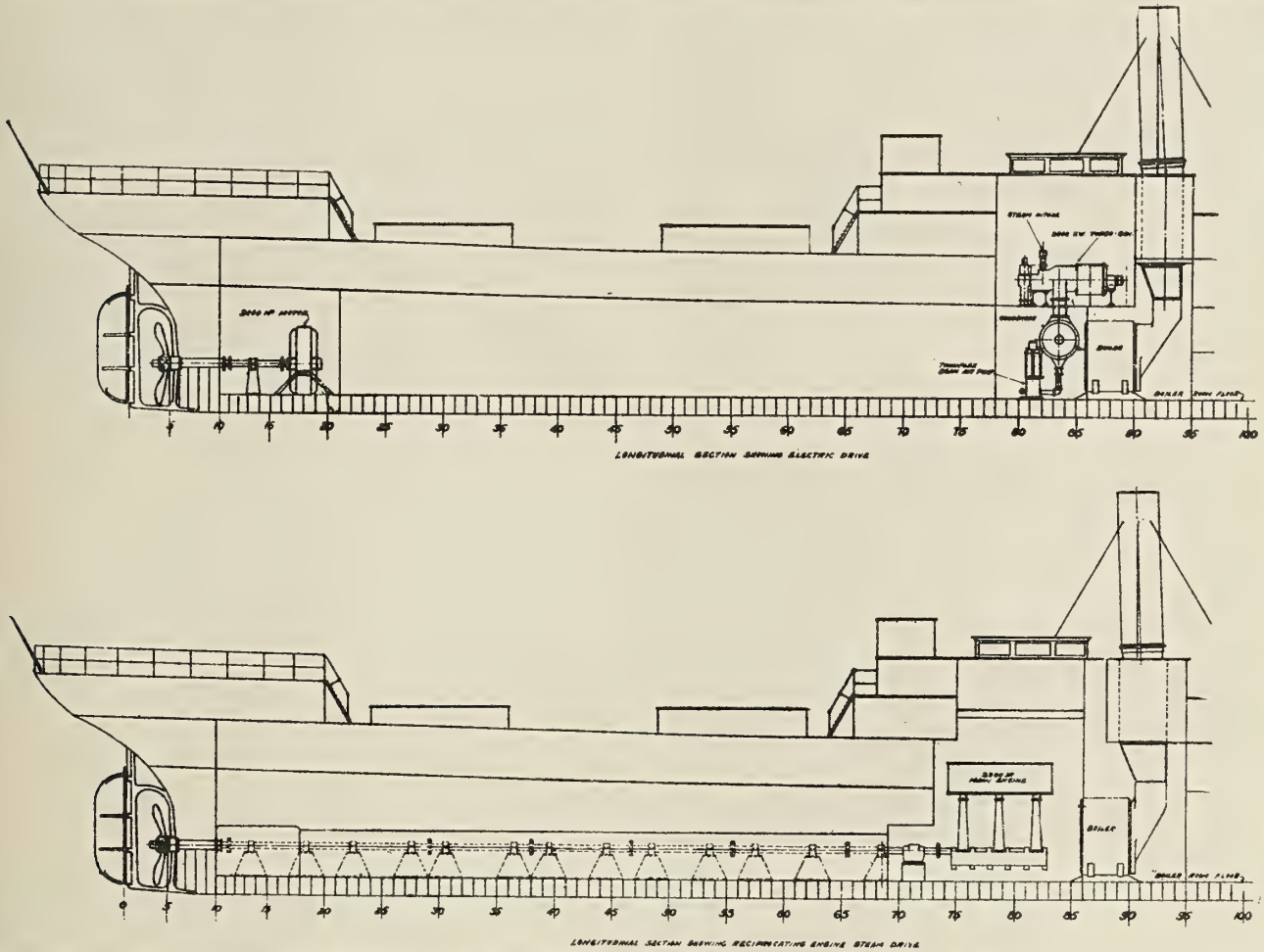
not including auxiliaries, will amount to 9.5 pounds. Under normal conditions at sea, with most of the auxiliaries driven electrically, this should give a steam consumption for all purposes not greater than 11 pounds per shaft horsepower hour. Such a steam consumption will require at least 30 percent less fuel for all purposes than would be required by a good reciprocating engine equipment operating without superheat, and even if an equal superheat were used with a reciprocating engine equipment, the gain would still be over 20 percent.

In this connection it must be considered that large numbers of American ships are now being equipped with reciprocating engines and without superheat, although it has been amply demonstrated abroad that the use of high superheat is practical and economical.

If such a ship were in operation 250 days in a year between California and Australia, burning fuel oil at $1.00 per barrel, the saving in fuel over a similar engine driven ship operating without superheat would amount to about $17,000, and the increased freight capacity leaving California would amount to 585 tons, which is 7½ percent of the deadweight tonnage.

Reliability

A study of the records and uses of such electrical apparatus as is applied in this case will show that the equipment is less liable to interruption of service than any other form of single-screw equipment which is applied to vessels. With such an equipment, however, arrangements could easily be made by which the ship could be navigated about half speed with the main generating unit out of service. This could be done by providing a motor-generator set or rotary converter so arranged that the power of auxiliary generating units could be delivered to the main motor. In an electrically propelled ship, electricity is produced simply for one definite purpose, and the arrangement is simpler and more reliable than shore applications, where power is taken from large distributing systems. It is also possible to provide automatic means which, by interrupting excitation, guard against the possibility of serious damage through possible accidents or insulation failures. Such electrical apparatus of the type used in ships is very easily repaired, and, even when damaged, can generally be temporarily connected so as to be operative. The knowledge necessary for such repairs is very easily imparted and is constantly being practiced in our industries by persons who have had little or no electrical training.



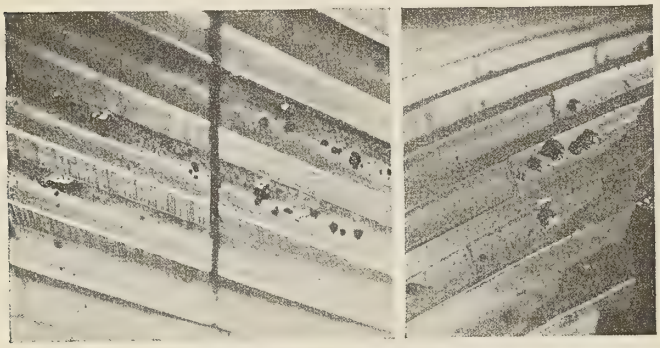
Figs. 1 and 2.—Machinery Arrangement of 8,800-Ton Ship Equipped With Electric and Reciprocating Engine Drive

Reliability of Gearing in Ships

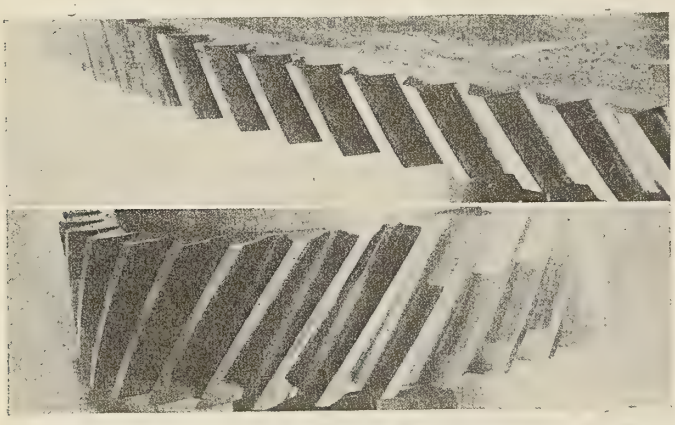
To make comparison of such an equipment with a gear-driven ship is much more difficult, since a great variety of arrangements of turbines and gears have been applied to ships of this type. In the matter of reliability, as has been said, the electrical equipment is entirely beyond question, while many evidences of serious trouble and deterioration have developed in geared ships of most types which have been produced. Gears have been very successful in many warships, but these are subject to only occasional short periods of high-power service. In some merchant ships gears have been very successful, and in others most serious trouble has been encountered. Variations of results in similar equipments in different ships illustrate some of the possible uncertainties. Parsons'

original gear applications operated with a single reduction, very small diameter pinions, and a large diameter gear on propeller shaft. Some of these have been reported to be very successful, but the gains in economy shown in Parsons' publications are nothing like so great as those accomplished by high-speed turbines with double reduction gears. There have, however, been many cases of failure with gears of this type. In fact, there seems to be no type of gearing with which trouble has not been experienced after long service in cargo vessels.

Recent production of so-called "Standard English ships" shows they are being equipped with double reduction gearing, and at the same time that this change of method is being adopted in England, the use of single reduction is being extensively advocated and applied here. Although all the original American equipments in merchant ships were double reduction, the writer has seen a solid-gear, double-reduction equipment of American make in which the gears were badly worn and pitted after 17,000 miles of service, and in this case the proportions of gears are closely equivalent to those which have been adopted in the new standard English ships, and the conditions of design and manufacture quite as good.



Low Speed Ship Gear and Pinion. Pinion Diameter, 11.44 inches. Pitch, 3½ inches. Normal load, 1,150 pounds per inch face. Tooth speed, 1,272 feet per minute. Time run, about 400 hours at sea.



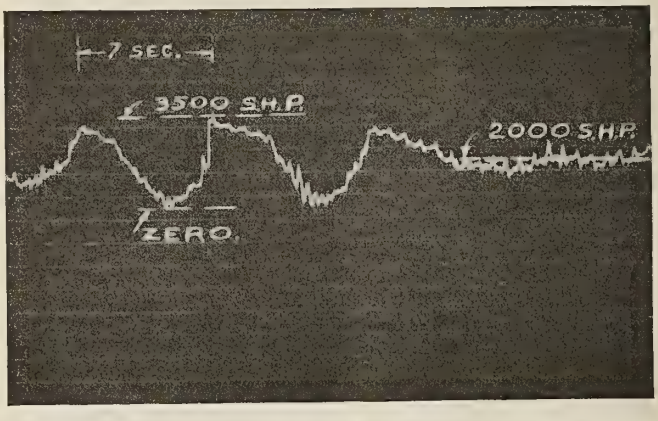
Experimental Gear Disk and Pinion. Pinion diameter, 7.28 inches. Pitch, 4 inches. Load carried, 3,000 pounds per inch face. Tooth speed, 7,000 feet per minute. Time run, 263 hours in Schenectady. Has made 8 times as many tooth engagements as above with a pressure, which, considering smaller pinion diameter, is relatively 4 times as heavy.

Fig. 3

These indisputable facts and many others certainly indicate that gearing for ships has not yet reached a state of finished development.

One of the uncertainties of gear operation in ships is illustrated by the very great difference in durability of gears in ship propulsion and in shore uses. In trials on shore, gears have borne without blemish, for equal periods, loads equivalent to approximately four times the average loads which have caused bad destruction of similar gears at sea. This is illustrated by the photograph shown in Fig. 3, and the data there given are characteristic of many other similar experiences which have developed.

The reasons for these astonishing differences have never been adequately explained. Fig. 4 shows a record taken from a torsion coupling on a cargo vessel operating in ballast in a moderate seaway. This record shows that the torque on propeller shaft varied from zero to approximately 75 percent overload under certain wave conditions. The effect of bad weather on endurance of gears has often been observed, and it is quite possible that variations much greater than that here shown may at times be experienced. In this case the ship was pitching only 4 degrees. Part of the small, quick variations shown in this record were caused by a transmitting ring which ran slightly out of true in the instrument, but otherwise the conditions were such that the record must be substantially correct.



Record for Torsion Spring Coupling on S. S. *Jebsen* in ballast in a moderately rough sea. Average R. P. M. 78. Average shaft horsepower, about 2,000. Part of the smaller fluctuations shown came from an untrue collar in the instrument, otherwise record is correct.

Fig. 4

Another matter of uncertainty in geared-turbine equipments is the matter of temperature in turbines. The operation of turbines in the reverse direction occasions large temperature variations, and temperature variations constitute a fruitful source of danger to turbine structures. Fig. 5 shows a record for temperature taken by a pyrometer situated between the nozzle and bucket of the last stage of a marine turbine while the turbine was being operated at normal speed in the reverse direction. It will be observed that the high temperatures shown by that record were produced in an extremely high vacuum by the introduction of small amounts of steam.

A turbine when operated in the reverse direction has a friction loss something like ten times as great as when it operates in a normal direction. In the General Electric shops it has been discovered that reversing wheels of marine turbines turn blue with heat when operated at normal speed in a vacuum of 20 inches. While no definite information can be given concerning the possible effects of high superheat in reversals of a marine turbine, the facts here given indicate that such effects may be serious and should, if possible, be avoided. A turbine which is kept running in its normal direction is not subject to any large temperature variations. The economies incident to the use of superheat on shipboard are very great and cannot long be neglected, although there have been few applications of superheat to American ships. The following extract from a letter from Van Nievelt, Gou-

driaan & Company, Rotterdam, Holland, illustrates the superheat possibilities in engine-driven ships:

"We are using during the last five years, in our multitubular boilers, 3½-inch tubes, very high funnels and Diamond blowers, and have no trouble at all in getting sufficient steam. We have practically no leakage at the connections of the pipes and boxes. The original pipes are still in use. The capacity of a 20-ton evaporator is sufficient for supplying feed water.

"Three of our steamers have been running half a year without superheaters, with a coal consumption of 24 to 25 tons. After fitting superheaters the consumption was about 22 tons, making a saving of at least 10 percent."

In electrically-driven ships the gain is quite as great as is here shown, and no practical difficulties can result even from degrees of superheat which would be impracticable with reciprocating engines.

Efficiency of Transmission

The selection for comparison of a ship of low power is unfavorable to the electric drive in the matter of transmission efficiency, the conditions being better for this method in ships of higher power. The generator designed for this case has an efficiency of 95.6 percent and the motor 95.9 percent, making the transmission efficiency, including cable loss, etc., 91.6 percent. In machinery designed for certain high-power ships, the efficiency is as high as 94 percent.

To determine the efficiency of gear transmission as compared with the figure given above, very careful tests

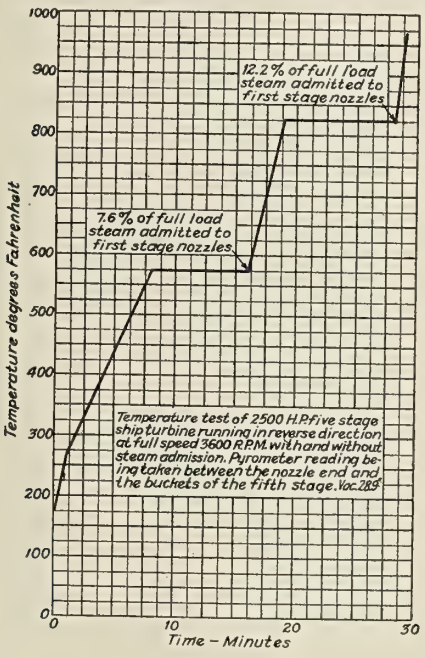


Fig. 5

have been made at Schenectady. A 2,400 horsepower ship turbine was connected through two sets of double-reduction gearing to a generator, and the steam consumption was tested at various degrees of load and speed; then the same turbine was connected to the same generator without gearing, and tests were run with the same conditions and the same degree of steam flow. All this was done on a testing stand where conditions are uniform and accurate; the gears ran with perfect smoothness, and all conditions were favorable. Since the comparison gives the loss of two gears, the differences are considerable and the determination should be very close to the correct value. This test showed that the performance of a single gear is as follows:

Shaft Horsepower	Revolutions per Minute	Loss of two sets of gears	Efficiency of gears
2,400	87	250 horsepower	95.0%
1,420	77	160 horsepower	94.7%

In addition to these gear losses, we must also consider the loss in friction of the reversing turbine, which is estimated from reliable data to be 28 horsepower, and we must also consider the bearing losses on about 100 feet of shaft, which in perfect alinement will be 8.5 horsepower. These additional losses reduce the transmission efficiency to 93.5 percent, leaving only 1.9 percent advantage to the gearing. With shaft more or less out of line and gears operating under sea conditions, it is probable that the losses given would be greatly increased. Noise is an indication of loss, and most marine gears are at times noisy, while the gears in this test were almost silent. The gears tested in this case were of the General Electric Alquist type, and it might be claimed that other kinds of gears would be more efficient, but it is obvious that, under fixed load and with similar gear speeds and diameters, there could be no advantage in any other type, even if it ran with equal smoothness.

Cost

In the present condition of prices it is very difficult to compare costs, but the cost estimates of the General Electric Company on electric equipments for cargo boats and geared equipments of recent design indicate that the electric is slightly cheaper. If we consider savings in shafting support, shaft alley, oiling system, etc., the saving with electric drive should be as much as 20 percent of the cost of the driving machinery.

Propeller Speeds

In ships requiring less than 3,000 horsepower, there is some practical disadvantage in using propeller speeds below 100 revolutions per minute, because of the large number of motor poles required if a high-speed turbine is adopted. Studies recently made by the Navy Department and elsewhere have indicated that there is practically no disadvantage in using a propeller speed of 100 revolutions per minute on an 11-knot, 2,400-horsepower ship, but in all cases of electric drive the matter of propeller speed should be carefully studied. In ships of higher power it is not desirable to use extremely high turbine speeds, and therefore there can be no difficulty about propeller speeds. Even in low-power ships, lower turbine speeds could be used if expedient, but this is disadvantageous to a small turbine, and the relative advantages and disadvantages should be duly considered.

Operating Force

The history of the electrical industry has repeatedly shown that persons who have not used electrical apparatus assume that its operation requires a high order of skill and expert knowledge, and of this assumption we have already heard much in connection with electric drive for ships. A vast amount of experience had repeatedly shown that this assumption is the direct reverse of the truth, and a little thought as to the conditions in electrical apparaus should make the reason obvious. Conductor circuits are much simpler mechanically than pipes and mechanical motions, and electrical machinery is simply a combination of electric circuits with motion of rotation. The connections are easily shown by diagrams, and little mechanical skill is required to make them. The work of insulation can be so done that, under such conditions as exist in ship installations, troubles which might involve difficulty of repair by unskilled persons are very improbable. In all the extensive uses of electricity in mills, mines, railways, and other industries, it has seldom failed to immediately become popular with the operating forces.

Elecrical Repairs on Ex-German Ships

Nature of Damage to Electrical Equipment by Sabotage—Alterations and Replacements —Generators and Motors, Lighting and Communication Systems

BY JOSEPH STANSBURY JONES*

VERY little has been known until recently of the measures taken by the Government to utilize the German ships interned in the early days of the war as troop transports, cargo carriers, animal transports and the like. Not the least important of the repairs made necessary by the destruction of machinery by the ships' crews was that of the electrical equipment which, originally of inferior quality, was hopelessly ruined by sabotage.

When this country entered the war there were 109 interned German and Austrian ships in the ports of the United States and its possessions, comprising 95 (610,265 tons) Germans and 14 (67,817 tons) Austrian. These ships represented a total gross tonnage of 678,082. At the port of New York in the third naval district the following eleven ex-German ships and one ex-Austrian ship were interned:

Former Name	Present Name	Length in feet	Gross Tonnage
Grosser Kurfurst	Aeolus	560.6	13,102
Kaiser Wilhelm II	Agamemnon	684.3	19,361
George Washington	George Washington	699.1	25,570
Friederich Der Grosse	Huron	523	10,771
Vaterland	Leviathan	907.6	54,282
Koenig Wilhelm II	Madawaska	490.4	9,410
Barbarossa	Mercury	526.3	10,984
Princess Irene	Pocahontas	523.5	10,893
Hamburg	Powhatan	499.3	1,053
President Grant	President Grant	599	18,072
President Lincoln	President Lincoln	598.8	18,168
Martha Washington	Martha Washington	460	8,312

These ships were selected by a joint board as being suitable as troop transports. After a thorough survey, they were distributed to various shipyards for the purpose of making necessary repairs and alternations to fit them for their future uses.

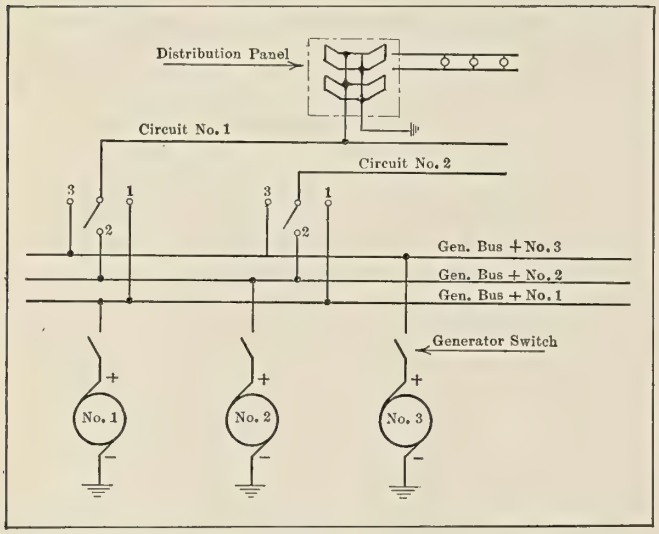


Fig. 1.—Method of Connecting Load to German Generator Sets

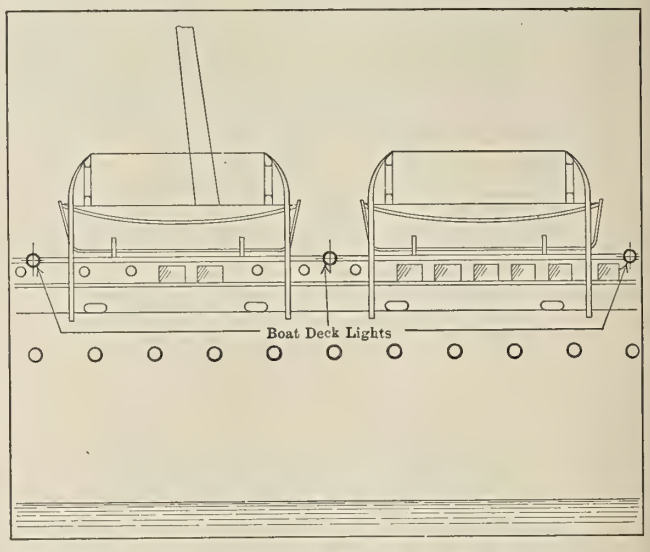


Fig. 2.—Auxiliary Lights Fitted on the Boat Deck

Generators and Switchboards

An inspection of the electrical equipment revealed that the commutators and the generators had been smashed with sledge hammers, carbon brushes removed and destroyed, rocker arms and brush holders broken beyond repair, field and armature windings damaged and acid and ammonium chloride poured into the dynamo engine cylinders, causing corrosion of the pistons and rods. Needless to say, any operation of the sets so treated was impossible. The generating sets on several ships were so badly damaged that it was necessary to remove them to the repair shop. Other sets were repaired in place. All of them were put in shape in remarkably short order and were required to operate at full load for forty-eight hours before they were considered satisfactory.

Most of the ships mentioned were equipped with generating sets of an old type, usually of German manufacture, and, in general, arranged for single wire systems with selective control switchboards. Fig. 1 indicates the method of connecting the load to the generators. The

The wiring throughout the vessels consisted of a single conductor armored with spirally-wound steel tape. Insulating material on most of the wiring was in bad shape and caused many petty fires until it was replaced.

The superabundance of fixtures in the cabins and saloons lighted these spaces brilliantly while the machinery spaces and cargo holds were very poorly illuminated. All fixtures were of German design, highly ornate but not ornamental, and fitted with either single or double contact bayonet-type sockets. Many odd styles and voltages of bayonet based lamps contributed to the Hun idea of splendor.

Electrical Repairs

Upon undertaking the electrical repairs and alterations on these vessels, the greater part of the original installations had to be removed and replaced. Replacements were made with the best obtainable grade of commercial cable and wire. With the placing of all power and general lighting in a satisfactory operating condition, the question of additional electrical equipment to make these vessels suitable for use as troop transports presented itself.

*Engineer, Charles Cory & Son, Inc., formerly assistant electrical superintendent and senior electrical expert aide, Navy Yard, New York.

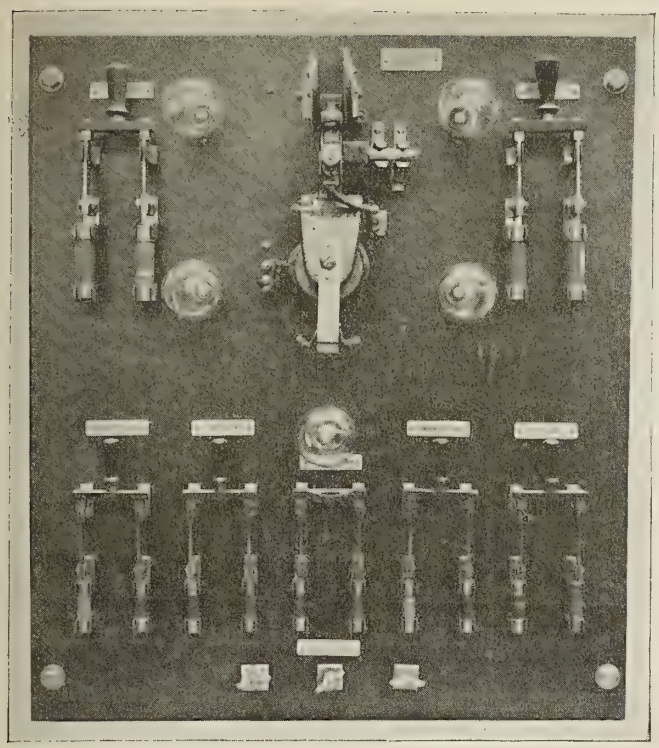


Fig. 3.—Arrangement of Relay and Distributing Panel in Radio Room

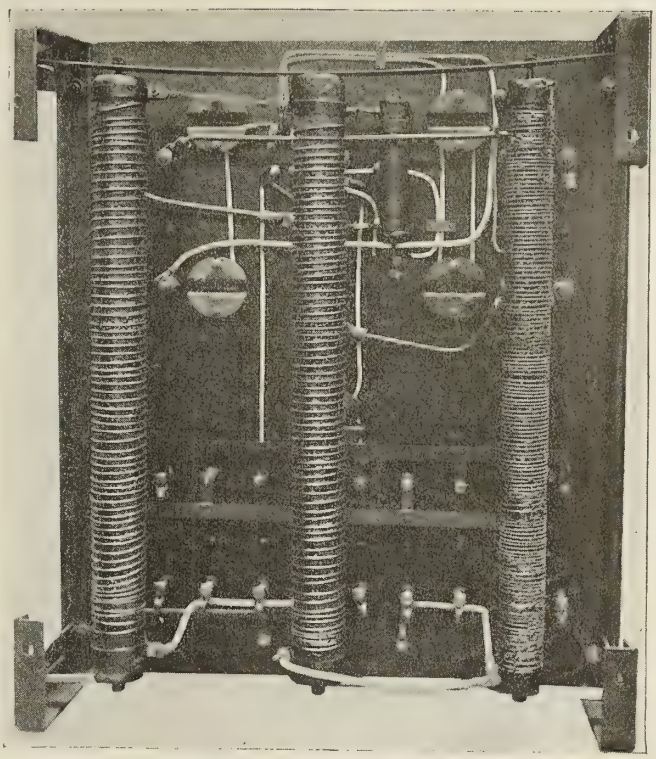


Fig. 3-a.—Connections for Relay and Distributing Panel

A list of commercial material considered suitable for marine use was compiled and distributed to contractors performing work on the ships in order that the best grades, as well as standardized equipment, might be installed. The number of different spare parts to be carried aboard ship was thus reduced. Conduit and copper-covered, armored cable were utilized in all machinery spaces so that the insulation would be watertight.

In the troop spaces the conduits were secured to the ships' frames instead of to the pillars. This means was taken to prevent damage by troops using the conduits for exercising purposes. Steamtight fixtures with globes and rugged guards were placed in all troop spaces to prevent the breakage of lights by troops during idle moments.

Boat Deck Auxiliary Lighting

For the boat deck system steamtight fixtures were fitted along the outboard strake on both the port and starboard sides between the adjacent boat davits. These lights, Fig. 2, were arranged for illuminating the boat-handling gear and the waterline to facilitate abandoning ship in case of a torpedo attack or from other causes. The auxiliary system was energized by a 25-volt, 140 ampere-hour, lead type storage battery located well above the waterline amidships and controlled by two double-pole, single-throw, knife switches inclosed in a metal case having a glass front.

Blue Exit Light System

A 140 ampere-hour, 110-volt lead type storage battery located on the boat deck in a suitable battery locker near the centerline of the vessel was used to energize the blue exit lights. This battery supplied current to circuits controlled through the relay and distributing panel, Figs. 3 and 4, located in the radio room. Current for charging the battery was supplied by any of the generators operating and fed through the main switchboard. The circuit feeding the relay-distributing panel was considered a battle circuit and was left on at all times. Fixtures were placed at all exits, troop compartments, crews' quarters, companion ways, engine rooms, firerooms, etc., but never in such locations as would be visible from outside the ship. All fixtures on this circuit were either of the deck or bulkhead type as required and equipped with steamtight, low visibility, blue globes and rugged guards.

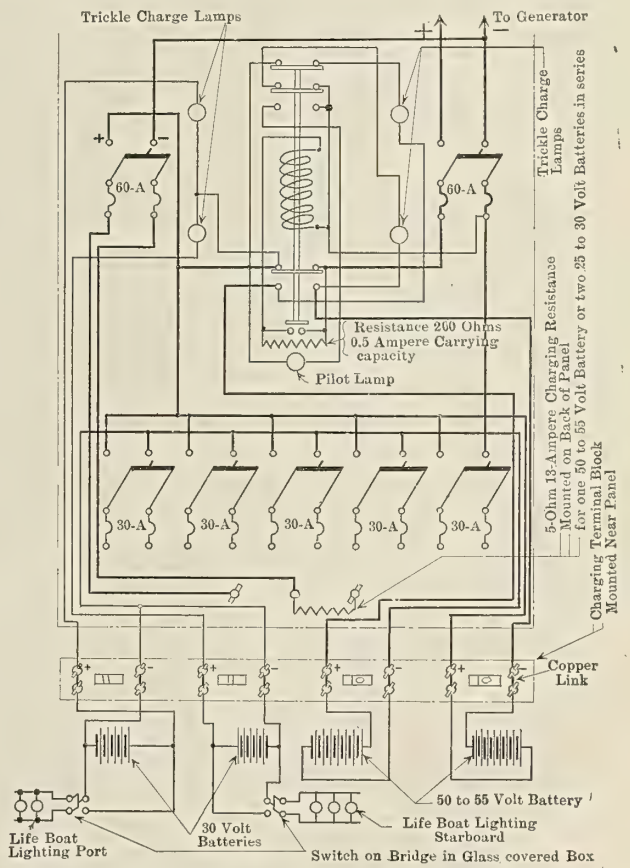


Fig. 4.—Wiring Diagram for Relay and Distribution Panel

The standing light system consisted of a separate circuit from the main distribution board, energizing lights in each compartment and troop space and arranged to be kept on continuously when the ship was otherwise darkened. Sufficient lights were installed on the bulkheads, in compartments about 3 feet above the deck, to provide

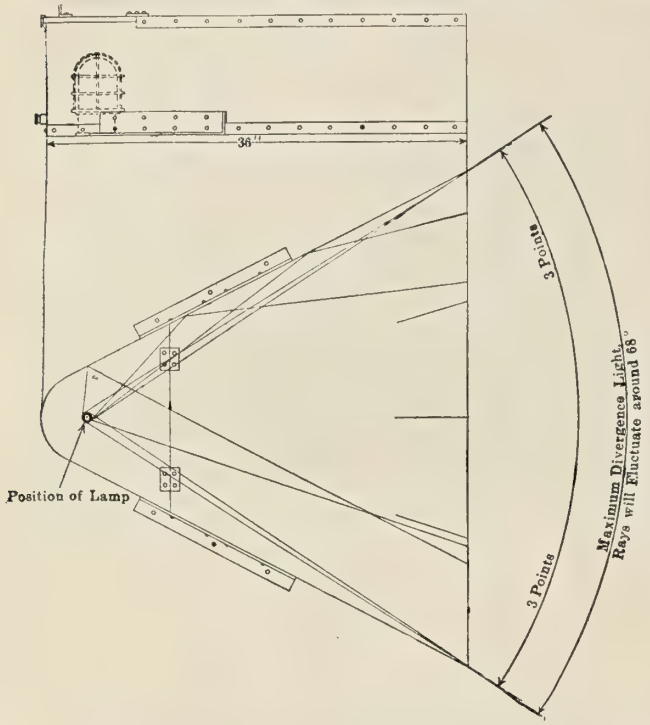


Fig. 5.—Screened Stern and Convoy Lights

adequate illumination for moving about. Lights were also placed at the scuttle butts, latrines, shower baths, etc., in order that these spaces might be used at all times.

A standing light system was installed to enable the crew to find their way around the troop compartments when the main circuit was extinguished for the night.

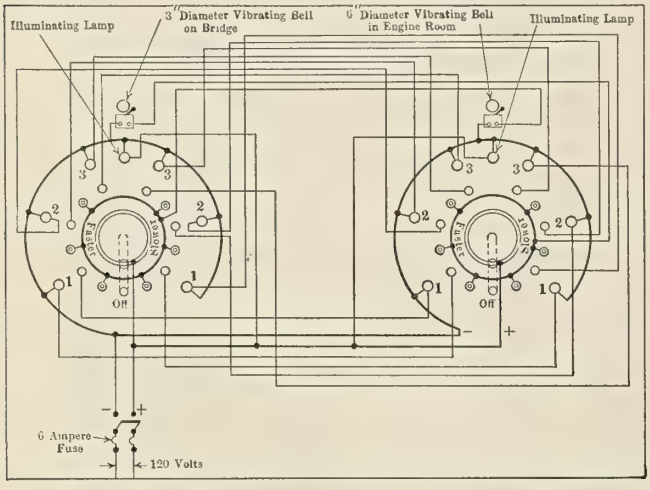


Fig. 6.—Engine Revolution Telegraph System Wiring

Each magazine was equipped with an individual standard magazine fixture energized from the auxiliary blue exit light circuit and controlled by a 5-ampere, watertight switch located outside the door leading to the magazine. A fixture in the bottom of the trunk leading to the magazine was placed in a position to reflect the light into the magazine when the door was opened. This light was controlled by a 5-ampere, watertight switch located at the top of the trunk leading to the magazine.

Two screened lights, known as screened stern and convoy lights, Fig. 5, were placed on the after side of the mast, one 60 feet above the other at the extreme stern of the vessel. These lights were operated by switches on

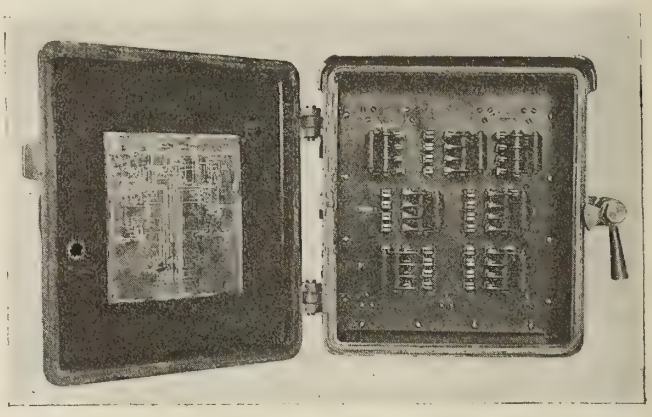


Fig. 7.—Master Station for Fire Control Telephones

the navigating panel in the pilot house. Their effective radius of illumination was from 3 points off the port quarter to 3 points off the starboard through an angle of 67½ degrees. The two lights at a fixed distance apart made possible the determination of the distance between ships by the triangulation method, so that they could maintain the proper intervals in convoy as well as maneuver at night in safety. Low visibility blue lamps, invisible to the eye at a distance of about 1,000 yards, were fitted to the convoy lights.

Automatic door cut-out switches with the necessary circuits for the control of lights in the chart room and

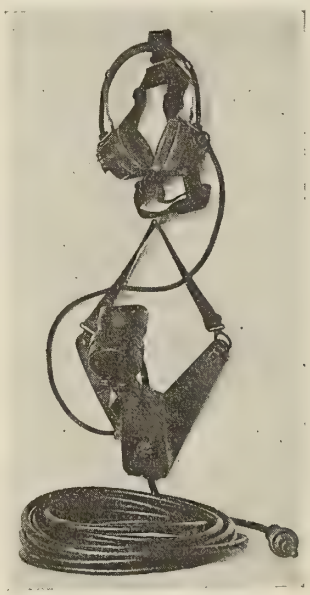


Fig. 8.—Loud Speaking Telephone Equipment

other compartments insured darkness on the weather deck when the ship was running in the danger zone. Where the number of lights in any social hall, wardroom, or other compartment opening on the weather deck, exceeded ten, all doors leading to such compartments had to be equipped with cut-out switches connected in series with the solenoid of an automatic relay.

A fused switch and distribution panel was arranged in the pilot house for the individual control of the navigating circuits, each switch being provided with a suitable name plate to indicate the light or signal controlled. This panel was fed directly from the main switchboard, and designated as the battle circuit and as such had to be kept ener-

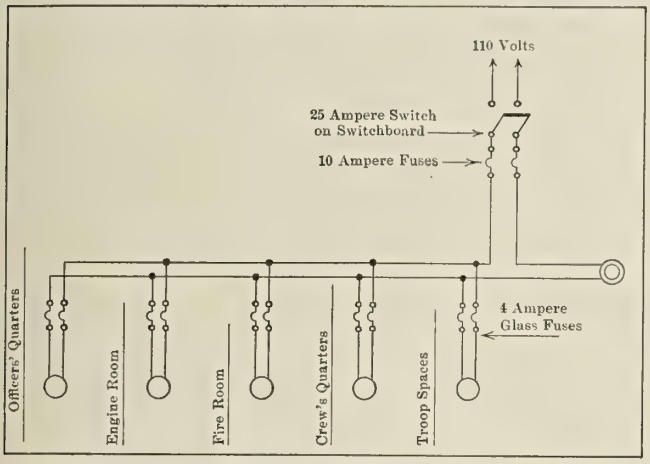


Fig. 9.—Alarm Gong System Installed on Troopships

gized at all times. The following appliances derived power from the navigating circuit panel:

Mast head light.
Towing light.
Port side light.
Starboard side light.
Range light.
Stern light.
Screened stern light.
Convoy light.
Blinker signal set.
Two 12-inch incandescent signalling searchlights.
Man overboard and breakdown lights.

A double-pole, single-throw fused switch installed in the pilot house was provided for de-energizing the navigating circuit panel. The starboard and port lights might also be cut on or off from either side of the bridge by means of switches on each wing. When the ships were running in darkness, it was sometimes necessary to flash a starboard or port side light upon approaching other

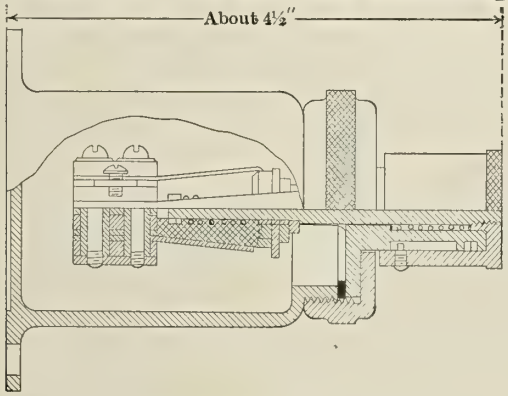


Fig. 10.—Alarm System Contact Located on the Bridge

ships in order to give warning as to the side on which they should pass.

Motor-Driven Equipment

Suitable direct-connected motor-driven ventilation sets (about 20 sets per ship) delivered 100,000 cubic feet of air per minute at a total head of 2.2 inches of water, in addition to the motive-driven ventilation already installed, were required to properly ventilate the troop and crew spaces.

A separate circuit from the main switchboard was installed with outlets on the bridge and lookout stations for foot warmers, each requiring about 200 watts. These were furnished for the purpose of making the officers and men on watch comfortable during the severe winter months.

Ship Telephone Service

Return call bells, paralleling voice tubes between fire-control stations and lookout stations, were included in the equipment in order that the attention of any lookout or fire-control station could be obtained in case a submarine were sighted.

Ship service telephone systems, averaging about 50 lines, were installed on the majority of the larger vessels. Each telephone system consisted of a commercial installation with the exception of the telephones placed in machinery spaces and where exposed to the weather. Here

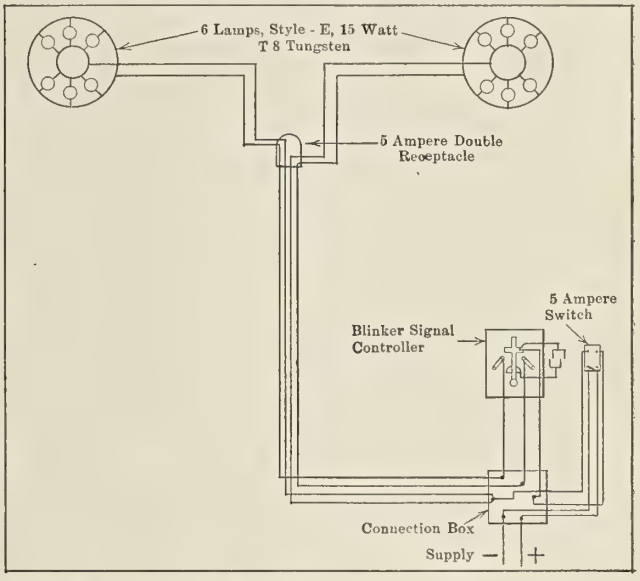


Fig. 11.—Yard Arm Blinker Signals Located on the Bridge

they were protected by means of watertight composition boxes.

The conductors used were of standard lead-covered No. 22 B. and S. gage telephone cable, insulated with two layers of silk and one layer of cotton braid, paraffin treated. Connections from the box or distributing frames to the telephone outlets were made with No. 18 soft-drawn rubber covered, weatherproof, twisted-pair, bridle wire. The conductors in exposed locations were clamped to the bulkheads by means of clips 12 inches apart. Conductors passing through hatches or at other points, subject to mechanical injury, were protected by suitable lengths of proper size conduits. All conductors in ducts or watertight bulkheads had to be made watertight by means of Navy standard stuffing tubes. Each installation after completion was required to withstand a resistance test of 500 megohms.

In order that ships might maintain the required speed and distance in convoy it was necessary to have an engine revolution telegraph system consisting of the round pattern, cast instrument known as the one, two, three faster-and-slower type, Fig. 6.

Due to the desire on the part of the Government to conserve the supply of Navy standard lead and armored cable, 20-conductor, known to the trade as aerial telegraph cable, was used for these installations. This cable was not carried through conduits but made watertight where it passed through compartments and decks by means of stuffing tubes and was protected against me-

chanical injury at such places by 18-inch lengths of guard tubing. Before going into service, all cable was given a coat of shellac and carefully painted.

Duplicate loud speaking telephone equipments were installed for communication between important stations.

Master Stations

The master stations for the port and starboard systems, Fig. 7, were located in the forward fire control station side by side so that both systems could be operated by either one or two persons, as desired. Telephones, Fig. 8, were used by the lookouts in connection with alidades for making submarine observations and reporting to the officer in charge at either the forward or after fire control stations. Communication was also established between the forward and aft fire control stations in order that gun fire might be directed from either one. The starboard control panel jack was located in the forward station. This arrangement permitted both the forward group of guns and the after group to be controlled from either or both stations. Energy for the fire control apparatus was supplied by a 20-volt storage battery furnished with a rheostat for charging the battery from the ship's generators.

General Alarm System

A general alarm gong system, Fig. 9, with a contact-maker, Fig. 10, located on the bridge with 6-inch watertight, vibrating gongs energized by the ship's voltage was installed in order that the alarm could be given in case of attack by the enemy.

Warning signal systems, consisting of approved commercial type industrial howlers with contact makers in each fire control station, were located as follows:

One between the forward guns.

One each in the forward and aft gun crew's living quarters.

One aft between the guns.

One between each pair of guns, if more than four were mounted on a vessel. This system was provided so that the gun crews might report at their combat positions before the troop calls caused the decks to become congested with men making their way towards the boats.

Yard arm blinker signals, Fig. 11, with controllers mounted on the bridge, were arranged according to Navy requirements for the purpose of providing mechanical signal arrangements between ships.

On the after mast were the "man overboard" and "breakdown" signal systems consisting of two double lanterns, the upper half of each being fitted with a red lens and the lower half with a white lens. These signals were energized through a switch on the navigating panel in the pilot house and the lights operated by a controller on the bridge.

It was found that the additional electrical equipment installed required an additional distribution panel to adequately care for the circuits. To this end a standard panel was developed and made part of the equipment on each vessel in addition to the ship's main switchboard.

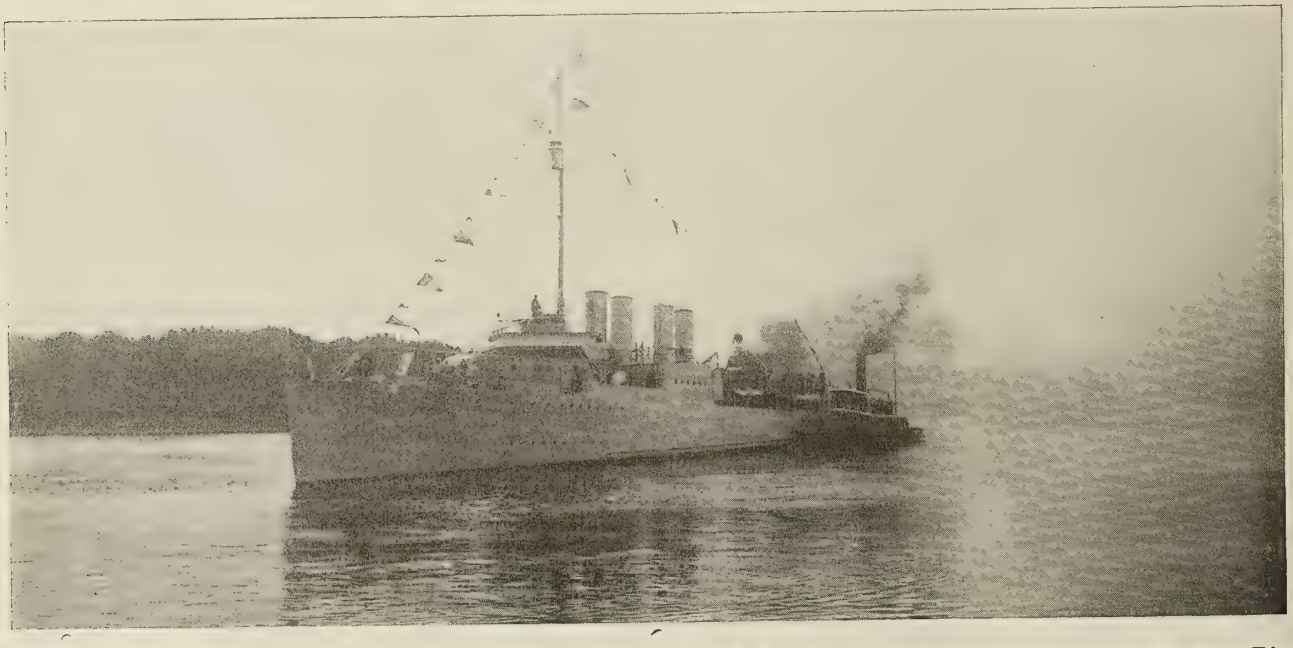
Last of the Destroyers at Fore River Delivered

Thirty-sixth Vessel Just Completed Will Be Flagship of 45th Destroyer Division

THE Quincy works of the Bethlehem Shipbuilding Corporation has completed its war program of thirty-six torpedo boat destroyers for the United States Navy. On September 23, the *Turner* cast off her lines at the yard and started on her short run to the Charlestown Navy Yard, where she was delivered.

Previous to the departure of the *Turner* a mass meeting took place in one of the shops, over which Superintendent Gould of the Quincy plant presided. In reviewing the destroyer program Mr. Gould complimented the workmen for their loyal service in placing the Fore River plant at the head of the shipbuilding industry during the war. Naval Constructor Hilliard called attention to the fact that the completion of thirty-six destroyers in twenty-seven months is a shipyard record which never had been duplicated.

The *Turner* is to go to the Pacific ocean and will be the flagship of the Pacific 45th destroyer division.



The United States Torpedo Boat Destroyer "Turner," La st of 36 Destroyers of Contract Completed by Fore River Plant, Bethlehem Shipbuilding Corporation

Naval Architects' Annual Meeting

Twent-seventh General Meeting of the Society of Naval Architects and Marine Engineers—Abstracts of Papers Presented and Discussion

THE twenty-seventh general meeting of the Society of Naval Architects and Marine Engineers was opened in the Engineering Societies building, 29 West 39th street, New York City, on Thursday morning, November 13 with Rear Admiral Washington L. Capps, U. S. N., president of the society, in the chair. The secretary-treasurer's annual report was read by Daniel H. Cox and approved.

As a result of the efforts made during the past year to increase the membership of the society, ninety-two new members, 45 associates and 9 juniors were unanimously elected so that the total membership at present is 1,447, as compared with 1,393 on November 1, 1918. The financial report indicates that receipts for the year amounted to $28,329.61 (£5,900). Disbursements of $29,463.17 (£6,050) were made. The resources of the society at the present time amount to $51,028.60 (£10,500).

The following deaths were recorded during the year: Members, Edward P. Bates, Marshall T. Davidson, William D. Dicky, Richard L. Newman, John M. Williamson; associates, Clement A. J. Griscom, Jr., William H. Pleasants, Richard C. Veid.

Election of Officers

The following officers were elected for the terms specified:

Vice-Presidents (for term expiring December 22, 1922)—A. P. Niblack, R. M. Watt, H. D. Goulder, C. P. Wetherbee.

Members of Council (for term expiring December 31, 1922)—R. A. C. Smith, Albert W. Goodrich.

Executive Committee (for term expiring December 31, 1922)—Stevenson Taylor, Andrew Fletcher, W. M. McFarland, F. L. DuBosque, J. W. Powell.

Secretary-Treasurer—Daniel H. Cox.

Committee on Papers—William McFarland, F. L. DuBosque, H. L. Aldrich.

As has been customary in the past a brief review of the progress in the shipbuilding and marine engineering fields was given by the president. Data compiled during the war have not yet been released by the Government so that it was not possible for actual figures to be used. Present conditions were compared with those of three different periods in the past twenty years, as reported in previous transactions of the society.

After the president's address, a list of associate and junior members were elected to higher grades.

The reading and discussion of the papers was then begun, the first paper being read by the acting secretary on account of the absence of the author.

Method of Construction of Concrete Ships

BY R. J. WIG

Abstract

The complete programme of concrete shipbuilding of the Fleet Corporation comprises the construction of fourteen ships of five different types. Two of the ships were considered of experimental character and constructed under contract in private yards. One of 3,000 tons deadweight was designed by the Liberty Shipbuilding Company, Wilmington, N. C. The hull was built by them in a private yard at Brunswick, Ga. The outfitting and installation of machinery was done under contract by the American Shipbuilding Company of Brunswick, Ga. The other ship was of 3,500 tons deadweight and was designed by the Fougner Concrete Shipbuilding Company of New York. The hull was constructed by the designers at Flushing Bay, N. Y., but the outfitting and installation of machinery were done by the Lord Construction Company of Providence, R. I.

The remaining twelve ships were constructed in yards owned by the Emergency Fleet Corporation and especially designed and built for the purpose. The yards were built and operated by contractors who acted as agents for the corporation. Following is a list of the contractors and a statement of the location of the yards and the number and type of ships built.

The San Francisco Shipbuilding Company, operating the yard at Oakland, Cal., is constructing complete two 7,500-ton deadweight concrete oil tankers, and one 7,500-ton deadweight cargo ship. The Pacific Marine and Construction Company is operating the yard at San Diego, Cal. It is constructing complete two 7,500-ton deadweight concrete oil tankers. Fred T. Ley & Company, Inc., of Boston, Mass., is operating the yard at Mobile, Ala., and is constructing complete two 7,500-ton deadweight concrete oil tankers and one 7,500-ton deadweight cargo ship. The A. Bentley & Sons Company, of Toledo, Ohio, is operating the yard at Jacksonville, Fla., and is constructing the concrete hulls for two 7,500-ton deadweight oil tankers. The tankers are being outfitted by the Jacksonville Ship Outfitting Company at Jacksonville, Fla. The Liberty Shipbuilding Company is operating the yard at Wilmington, N. C., and is constructing ten 3,500-ton deadweight concrete hulls. The outfitting is being done by the Jacksonville Ship Outfitting Company.

The author describes in considerable detail the methods of blocking and scaffolding, the construction and use of outside and inside forms, the kind and quality and methods of fabricating and placing reinforcing steel, the materials used for making concrete and methods of placing concrete, together with complete details of launching, painting and outfitting the vessels.

At the time of writing, only the 3,000 and 3,500-ton deadweight experimental concrete ships have made their trial trips. On the trial trip of the *Polias* (3,500-ton deadweight) the log shows that she was run for six hours at full speed, averaging 10.5 nautical miles per hour. Over a 7-mile stretch of this course, the speed was figured at 11.4 nautical miles per hour. At this speed her engines were making 93 revolutions per minute and indicated 1,364½ horsepower. The guaranteed speed of the *Polias* was 10.5 nautical miles per hour.

Both the *Polias* and the *Atlantus* handled very much as a steel ship of similar size and lines, and with the same type engines would handle. The chief difference which was noticed by everyone on the trial boards was the marked lack of vibration on the concrete ship. One other point, which was formed in both concrete ships, is that they backed nearly straight and can be steered slightly while backing.

At the time of writing, total costs are available on the hulls of four 7,500 deadweight ton reinforced concrete oil tankers. The net cost for the hull alone ranges from

about $600,000 to $700,000. As yet none of the larger ships has been completely outfitted, and no figures are now available as to the final cost of this work. The partial figures now on hand would indicate that the outfitting would cost, including material and labor, about $600,000 for each 7,500-ton ship. The tankers will therefore cost in the neighborhood of $1,250,000 or about $167 per deadweight ton. This figure should be compared with the $225 to $300 per ton cost for steel tankers built during the same period.

The concrete ship, the author claims, is a practical structure and, if properly designed and built, will resist the normal stresses to which ships are exposed at sea. It has, however, one inherent weakness. The 4-inch shell of a concrete ship will not resist local impact of moderate intensity to the same extent as the shell of a steel ship of the same capacity. Up to the present writing, no concrete ships have been exposed to collision or severe impact, therefore the behavior of a concrete ship under such conditions is unknown. As a compensating feature, it has been found that concrete ship hulls are more easily and cheaply repaired than steel ship hulls. On account of this more friable character of the shell of a concrete ship, it is necessary that it be handled more carefully than a steel ship when in harbor. It is possible some means will be found to obviate this weakness.

The future utility of the concrete ship depends upon two factors—one, its durability, and the other is economy of operation as compared with wood and steel ships. The final durability of the concrete ship can only be determined by years of experience, but it is quite probable that two or three years of operation of the ships now building will furnish some indication of the life which may be anticipated.

When the concrete ship has demonstrated its durability, many situations will be found where it will prove more economical than either wood or steel in spite of its greater hull weight, which probably can never be entirely overcome.

Discussion

Alfred J. C. Robertson stated that when every shipyard was working hardest and the steel plants busiest the concrete ship was produced to fill an immediate need for tonnage. The first work in this construction certainly was open to criticism but developments that have been made in concrete ships subsequently deserve an unbiased test.

Certain statements made in the paper on freeboard and displacement ratios for concrete ships are a little too optimistic when tested under actual conditions but these figures and other minor matters will be corrected by the author before the proceedings are finally published.

The first concrete ship, *Faith,* was more or less of a failure, although even after several months in the water her hull has not shown deterioration. However, the concrete ship and its possibilities should by no means be condemned because of the failure of this vessel to meet all her requirements.

Development of Shipyards in the United States During the Great War

BY CAPTAIN R. E. BAKENHUS, C. E. C., U. S. N.

Abstract

In 1912-1913 there were in the United States 49 shipbuilding yards with an estimated number of 184 ways. Of these yards 25 were on the Atlantic coast, 8 on the Pacific coast, 16 on the Great Lakes, and none on the Gulf. Early in 1917, before the United States declared war on Germany, the number of shipyards had increased to 132, with approximately 419 ways. Of these yards 66 were on the Atlantic coast, 32 on the Pacific coast, 27 on the Great Lakes, and 7 on the Gulf coast. By the fall of 1918—that is, before the armistice was signed and before any of the war yards were dismantled—the number had increased to a total of 243 yards, with approximately 1,202 ways, of which yards 117 were on the Atlantic coast, 64 yards were on the Pacific coast, 29 yards were on the Great Lakes, 32 yards were on the Gulf coast, with 1 inland yard on the Cumberland River in Tennessee, with two ways. These numbers include yards in which the Emergency Fleet Corporation had no interests, as well as those in which the corporation's vessels were built.

The total approximate estimated value of all the various yards engaged in building ships for the Emergency Fleet Corporation is $369,125,000; of this sum, the amount furnished from Emergency Fleet Corporation funds is approximately $220,973,000. It is impossible to estimate at this time the returns to the Fleet Corporation from the sale and salvaging of the various properties in which it has invested capital.

A careful examination of the data which has so far been prepared indicates very little uniformity in the extent of equipment provided for the various yards. Even in the yards of greatest efficiency, as indicated by their output, there is very little uniformity. This leads to the conclusion that the efficiency of a shipyard is less dependent upon plant layout than upon other factors, the principal one of which is, of course, the personnel. There is no doubt, however, that while plant layout is not the most important factor, it is nevertheless one of great importance in the establishment of a building yard. The study of a relation of plant layout to efficiency in plant output has not been contemplated in time to be outlined in this paper. It is therefore not safe to draw any conclusions at this time as to the exact function of plant layout in determining efficiency.

Steel Ship Construction From a Management Viewpoint

BY CREIGHTON CHURCHILL

Abstract

Published records show 21,800,000 deadweight tons of shipping lost since the beginning of the war, during which time 15,700,000 tons were constructed, making a net loss of 6,100,000 deadweight tons. The rate of construction for five years prior to the war was 2,300,000 tons per year, which, it is anticipated, will become about 5,000,000 tons per year until 1924 or 1925, when the rate of construction will become a matter of replacement and natural increase due to trade expansion, probably somewhere in the neighborhood of 3,000,000 tons a year. Naturally a very large percentage of this will be steel construction.

As of April, 1919, there were sixty-seven yards in this country with 425 ways capable of building steel ships of over 3,000 deadweight tons. There were under construction at these yards 637 steel vessels aggregating 4,225,000 deadweight tons, and 591 vessels, aggregating 4,200,000 deadweight tons, yet to be constructed. In this country alone, therefore, provision has been made to add some 8,425,000 tons to the world's shipping with a total yearly output of approximately 3,000,000 to 4,000,000 tons, depending on the type of ship. It is apparent, therefore, that it will take about two years to complete the present program, provided it was spread over the entire industry. This, however, is not the case, and it is estimated that at the close of the present year from 30 percent to 50 percent of the country's capacity will be available

for contracts for private account. In other words, a capacity of from 1,000,000 to 2,000,000 tons a year will be released, and it is tonnage to this amount that must be built to meet immediate demands and at the present prices of material and labor. If this business can be secured, it is the writer's firm belief that the shipbuilders of this country will find the means to develop the industry along modern lines such that its future will be assured.

During the war, time was the very essence of all contracts, with expense a less than secondary consideration. With conditions reversed and a reasonable time to adjust themselves on a strictly economical basis shipbuilders will continue in business only so long as they pay strict attention to factors under their control. A cursory analysis of the situation indicates that the factors under direct control of the shipbuilders are organization, management, method, and, to a greater or less extent, men. The prevailing market controls both material and wages, the latter through labor being considered a commodity, but as it is extremely doubtful if the market will continue to exercise its former control on wages, the element of wages is treated in this paper as one of the factors not under control by the shipbuilder.

It is a foregone conclusion, other things being equal, that the success of an industry is very largely a matter of organization and management. Assuming that the organization, management and methods fulfil requirements, the only remaining factor under control is the men. On this factor hinges final costs after defects in the other factors under control have been remedied. It may be of interest to know that the results of analytical studies of operations in over 50 percent of the steel yards engaged on construction for the Emergency Fleet Corporation during the war indicate that less than 20 percent of the faults developed were chargeable to the men. This is simply another way of saying that other factors under control were responsible for some 80 percent. Accepting this statement as correct, it will be shown that the combined result of reducing the faults of both men and management is a very material reduction in construction costs. In fact, the practicability of so doing is what confirms the writer in his belief that the shipbuilding industry will have itself to blame if it cannot stand on its own feet in the face of foreign competition.

In investigating the costs of ships of different types and cargo carrying capacity an intimate relation developed between fabricating capacity, number of ways, construction program and man efficiency, the last expressed in deadweight tons of output per man per year based on the entire force engaged on ship construction, exclusive of office force and men engaged on plant construction. A 7,500 deadweight cargo vessel was used in the calculations, with material costs as follows:

Hull, $212,952 (plates at 3¼c.; shapes at 3c.; bars at 2.9c.).

Machinery, $266,515 (2,899 horsepower reciprocating engines; three 13-foot by 12-foot Scotch boilers).

Equipment, $104,371 (military requirements, $30,000).

The labor cost was calculated on the basis of man efficiency, using $5.40 as the average daily wage of all men engaged on ship construction. To arrive at the number of men per way the following formula was used:

$$\text{Men per way} = \frac{300 \times a}{b \times c}$$

in which

a = fabricating capacity per 8-hour day.

b = tons steel erected per man per year.

c = number of ways.

300 = number of working days per year.

Launching was assumed when 90 percent of the steel was erected and riveted. A balance between fabricating, erecting and riveting was taken for granted.

A careful study of the data presented in the paper develops some very interesting results which may be expressed as laws and enumerated as follows:

1. For a given man efficiency there are a certain definite number of ways and a certain building program that will result in minimum costs.

2. As man efficiency increases costs decrease according to a diminishing ratio and not in direct proportion to increase of efficiency.

3. The lower the man efficiency the greater the number of ways and the longer the building program to secure most economical construction.

The intimate connection between man efficiency and building program show, beyond any question, the advisability of working to standards and setting such standards within reach of the working force. For example, if a contract were secured for delivery of a 7,500 deadweight ton cargo vessel in 155 days from keel laying (125 days keel to launching and 30 days launching to delivery), there is a possible variation in cost of about $117 and $158 per deadweight ton, depending on whether the yard can show a man efficiency of 65 deadweight tons or 25 deadweight tons per man per year with a fabricating capacity of 90 tons per 8-hour day. Obviously this difference is entirely a matter of labor cost and shows the necessity of paying all possible attention to man efficiency and making every effort to bring it up to a standard. It is suggested that standards be set in accordance with the following table which represents actual performance on cargo ships in going yards for an equivalent period of 120 months:

Deadweight Tonnage	Standard per man year	Values of b
3,500	30 deadweight tons	10
5,000	36 deadweight tons	12
7,500	45 deadweight tons	16
10,000	53.5 deadweight tons	20
12,000	61 deadweight tons	23

The values of *"b"* corresponding to the different man standards for ships of different tonnage is included in the above table because it is the basis for figuring the number of men per way to attain the given standard. (The values of *"b"* listed were derived from actual performance in twenty-three yards. Of these yards 37 percent manufactured engines and boilers, 32 percent either engines or boilers and the balance, 32 percent, neither engines nor boilers. This is mentioned that proper allowance may be made in the use of the formula for individual yards.)

Ship construction depends primarily on a balance being maintained between fabricating, erecting and riveting, with outfitting and machinery installation depending on the progress of these three elements. That the standards set may be used to best advantage, charts are suggested as a form for presenting performance to the men. The charts are based on building 7,500 deadweight ton cargo vessels in a five-way yard with 150 tons fabricating capacity on a predetermined 75-30 building program. Average daily performance by weeks is shown graphically, while figures are used to show this average to date. As drawn up, these graphs are intended for use by the general superintendent and the general foremen responible for the different activities. For the information of the men the same general idea can be followed out with such changes as may seem desirable. It is suggested that, for

this purpose, daily performance be used in connection with blackboards at each way and in the fabricating shops.

As a final example of the necessity of giving consideration to all the elements involved in shipbuilding, curves were developed as indicative of what happens in actual practice. A five-way yard was taken with a man efficiency of 35 equivalent deadweight ton per man per year. The problem is treated from two points of view, namely:

1. Constructing cargo vessels of different deadweight tonnage on a fixed 100-30 building program.

2. Constructing cargo vessels of different tonnages at a fixed fabricating capacity.

It is evident that a fixed building program involves different fabricating capacities and number of men per way for ships of different tonnage, while, with a fixed fabricating capacity, the men per way remain the same but the building program varies. That a proper comparison between these two conditions might be made, it was assumed that the yard was organized and equipped to build 5,000 deadweight ton ships on a 100-30 building program.

The conclusions to be drawn from a study of the curves presented show, beyond any question of doubt, that construction costs are dependent to a very large extent on tonnage, and, consequently, that each individual yard should confine itself to vessels that come within its field. Just what the field of any yard might be is determined from the most economical building program at a given man efficiency for ships of different tonnage. For a 7,500 deadweight ton cargo ship the most economical building program is 113-30 at a man efficiency of 35 deadweight tons. Corresponding to this program, the fabricating capacity should be 100 tons. The number of ways corresponding to the above would be five, consequently a five-way yard with 100 tons fabricating capacity would be in a better position to build a 7,500 deadweight ton cargo vessel than a yard differently equipped. Conversely, by the same method, the field of a yard can be determined, always keeping in mind the man efficiency. While a standard man efficiency of 45 equivalent deadweight tons* has been offered as a result of actual performance it is suggested that, in yards that do not come up to this standard, a tentative one of 35 equivalent deadweight tons be set up to work to. Unless this is done, it is not possible to figure definitely on results to be accomplished nor keep in close touch with day to day performance.

Discussion

Professor H. C. Sadler, who was associated in the work with Creighton Churchill, brought out the fact that this paper represented a complete study of all the data compiled on shipyard management during the war.

It has always been thought that to increase production in the shipyards it was necessary to increase the number of shipyards, increase their capacities and build new ways. As a matter of fact, however, the man power in a yard and its operating efficiency combine to influence the actual tonnage output. In the paper, Figs. 3 and 4 particularly give the actual cost per deadweight ton plotted as abscissae and the deadweight tons per man per year produced as ordinates for yards having a various number of ways. This question of the number of ways proves to be most important in studying the curves for in a five-way yard the cost per deadweight ton is less than in a ten-way yard.

Costs in the shipyards vary between $117 and $158 per deadweight ton depending on whether the yard shows a man efficiency of 65 deadweight tons or 25 deadweight tons per man per year. The greatest factor in this is of course labor cost, depending on man efficiency. If the nation is to compete with the powers of the world in shipbuilding production, costs must be reduced and this paper, if studied carefully, indicates various means of reducing production costs in competition.

In plotting the curves any shipyard can substitute figures representing local conditions and a check can thus be kept on production.

President Capps requested information on the relation between man efficiency and overhead cost, as mentioned in the paper. For the information of the members, Creighton Churchill based his conclusions on weekly and monthly reports of the Emergency Fleet Corporation which cover every yard in the country engaged in Government construction.

Data were separated into three divisions, coming under the head of plant construction, ship construction, repair and other work. The number of men engaged in all of these represented the actual number of men required to produce ships directly or indirectly. From the individual yard records of deadweight tonnage it was possible to arrive at the output in deadweight tons per man per year for the total number engaged in shipbuilding.

In arriving at the overhead costs to be charged against ships, it was found that 20 percent of the overhead was due to inefficiency of man power and 80 percent due to lack of control and organization. The cost of training men helped accumulate the 20 percent overhead from the first cost, while the cost of raw materials, inefficiencies in production, the losses due to the inexperience of the organization in shipbuilding all combined to produce the second factor in overhead. Labor inefficiencies maintained an average overhead cost per ship per day of $1,000. In general, the smaller the yard with a trained personnel, the more efficient production became.

Under normal conditions, the question of overhead will adjust itself so that the actual figures under stress of war conditions only serve as an arbitrary basis for future comparisons.

An Analysis of the Isherwood System of Ship Construction

BY JOHN FLODIN

(This paper will be published in an early issue.)

Discussion

John C. Reid in discussing this paper brought out the fact that the Isherwood system of ship construction had saved steel without lessening the strength of the ship. After an order for a ship has been given, its scantlings can be determined within twenty-four hours so that steel might be ordered immediately. For this reason, during the war, when the time element entered into every transaction, the system received a great impetus, and rightly so.

It can be used in a great many different types of ship and has the advantage of being very easily repaired in case of accident. On the Great Lakes, however, where a ship is subjected to scraping on the bottom, and in the canals, where she may be liable to rub the banks and locks, it has disadvantages because of long scores between the longitudinals. Passenger steamers have sufficient strength in their structures because of the number of decks, as well as double skins without the use of the system.

As an example of the strength of this structure, reference was made to the *Storstad* and *Empress of Ireland* collision, in which the *Storstad* rammed the *Empress of Ireland* at an angle of about 48 degrees and, glancing past, cut a 4-foot hole through all the decks of the passenger ship while the *Storstad* was damaged only about

* The term "equivalent deadweight ton" means performance referred to a 7,500 deadweight-ton cargo vessel as a standard for comparison.

12 feet of her length from the bow aft not quite to the forward collision bulkhead. In repairing the *Storstad* the acetylene torch was used to cut off the damaged section after which a new bow was put on in a very short time.

The fact that great caution must be exercised in longitudinally-framed ships to insure sufficient strength in torsion was brought out by Elmer A. Sperry. The tendency in the design of cargo ships has been to neglect the stiffness factor where large hatches have been cut into the deck.

The strength of a tube in torsion is very well known. When a tube is subjected to twist practically no distorsion is noticed in its entire length. If the tube is cut longitudinally, two gutters result. The ratio of torsion between the tube and the gutter is about 36,00 1. A ship although not exactly a gutter, according to Mr. Sperry, approaches it, if great strength is not supplied in the deck structure. The torsion exerted by wave action must be taken care of some way, and he claimed that the Isherwood system does this. Incidentally, a great amount of weight is saved in the use of this system.

THURSDAY AFTERNOON SESSION

Economical Cargo Ships

BY ALFRED J. C. ROBERTSON

(This paper is published on page 799.)

DISCUSSION

According to Professor H. C. Sadler this paper will prove of great value in producing cargo ships of the future for it is possible by substituting data from various plant records to arrive at the most economical ship sizes and powers to be used with a given design. The paper justifies the type of cargo carrying vessel used by the Emergency Fleet Corporation which is of the 8,800-ton type having a speed of about 10 knots. It has been estimated that the size of a ship alone determined its economy and that the larger vessels were more efficient. Plate 2, Fig. 6, however, in which ships' speeds are plotted against the deadweight tonnage moved per year for ships of varying lengths and speeds, shows that a 350-foot ship at a 10-knot speed has a greater annual carrying capacity than a 500-foot ship at the same speed.

The value of model experiments in ship design are not always given the credit due them and if they were followed a little more exactly, ships of superior design would certainly result. A week or two is usually required to produce the lines and calculations necessary to build a model. After the model has been tested for speed and performance in general, the material for the ship has already been ordered, and, although in many cases eight or ten percent of the power of a vessel might be saved by varying the design according to discoveries made from the model, progress on the ship has advanced too far for such changes to be incorporated.

The model will aid, if its performance is carefully followed, in producing the best ship for a given speed.

E. H. Rigg, naval architect of the New York Shipbuilding Corporation, commended this paper particularly to shipowners and operators, pointing out that many times an inquiry for a ship is based on some such analysis as given by Robertson in this paper or by Anderson, Urwin, Baker, Kent and Donald in similar papers read before sister societies in Britain. Other investigations covering the economics of still larger vessels are available, notably by Sir John Biles and Lord Pirrie, also by the Canadian Royal Commission on Overseas Communications.

Referring to line 36, Plate 1, Mr. Rigg called attention to the statement that the cost of manning and management is the same for each speed of any given length of ship. With horsepower for 13 knots practically double that of 10 it is difficult to see why engine room manning costs were not increased with speed. For double power about a 35 percent to 40 percent increase in engine room salaries and wages would appear to be in order. He believed that the idea of first stating the figures for the actual ship and then reducing them to a basis of each $1,000,000 invested will appeal to the operator and investor at once.

Fig. 3, Plate 2, gives a diagram of dwindling profits as speed goes up. It will be of interest to take this another way; that is, increase the freight rate to maintain equal profits as at 10 knots. These figures refer to the 3,500-mile voyage and minimum port detention, oil fuel at $6.00 and tonnage dues at $1.50.

TABLE OF GROSS FREIGHT RATES

Length of Vessel in Feet	Speed of Ship in Knots 10	11	12	13
350	$6.00	$6.33	$6.87	$7.82
400	6.00	6.27	6.71	7.32
450	6.00	6.24	6.57	7.08
500	6.00	6.25	6.54	6.98

This table shows clearly the advantage of the large ship at the higher speeds, the 500 feet ship can take freight at 84 cents per ton cheaper than the 350 feet at 13 knots. Still another interesting comparison is to take a fixed gross annual profit of $200,000 per million invested for all ships and see how the freight rates compare. This table works out as follows:

TABLE OF GROSS FREIGHT RATES

Length of Vessel in Feet	Speed of Ship in Knots 10	11	12	13
350	$5.91	$6.24	$6.78	$7.70
400	5.71	5.97	6.38	6.95
450	5.67	5.89	6.20	6.68
500	5.61	5.84	6.11	6.51

This table shows that a 10-knot vessel can always underbid the faster, other things being equal; it also shows that the 450-foot ship at 11 knots can underbid the 350-foot ship at 10 knots. This is another confirmation that the tendency to run at 11 to 11½ knots in the larger freight vessels is sound. The penalty paid for high speed in small ships is again brought out.

Mr. Robertson does well to direct attention to the painful results of undue detention in port. This again emphasizes adequate handling gear and terminal facilities as a necessary accompaniment to successful operation.

Non-Rolling Passenger Liners — Observations on a Large Stabilized Ship in Service, Including the Plant and Economies Effected by Stabilization

BY ELMER A. SPERRY

(This paper will be published in an early issue.)

Submarines in General—German Submarines in Particular

BY COMMANDER E. S. LAND, CONSTRUCTION CORPS, U. S. N.

ABSTRACT

Prior to the war, the opinion was prevalent that the submarine was essentially a defensive weapon and of little value as an offensive weapon. The facts revealed by the war have changed this opinion since the submarine has so efficiently proved its worth as a very powerful offensive weapon. Its ability as a scout was truly marvelous, as it was able to gain a maximum of information at a minimum of expense.

Among the things accomplished by the submarine one fact stands out as particularly noteworthy, namely, that more men-of-war were destroyed by submarines than by any other type of war craft. Likewise the submarines proved their efficiency in being the most effective means for watching the movements of the German fleet; in fact, much of the information obtained regarding the activities of German war craft was obtained by submarines on picket and patrol duty; furthermore, few movements of German war craft escaped their vigilance.

During the war, the British maintained a picket line with their submarines inside Heligoland Bight. This proved to be an extremely dangerous post to maintain, and the picket line was later withdrawn outside of Heligoland. The British lost six submarines in six weeks during one period of picket duty inside Heligoland; during the entire war they lost twenty-nine out of fifty-eight of their "E" class of boats. Owing to the very dangerous duty performed, it was considered that the normal life for these picket boats was twelve patrols, yet the "waiting list" at Harwich was the longest; this proves the metal of the British Submarine Navy.

The Germans had about thirty submarines at the beginning of the war; during the four and one-half years following they produced or had in process of construction at least six hundred and fifty more, making a total of approximately six hundred and seventy. Of these, two hundred and three were lost during the war. The number of allied craft engaged against the German submarines was in the approximate ratio of 200 to 1.

The German submarines destroyed about 15,000,000 tons of shipping and killed about 16,000 people during the war. During the last three months of the war they destroyed about 1,000,000 tons. It was only in October, 1918, that the construction of allied vessels covered the current losses caused by the German submarines.

In concluding my paper on "Submarine Hulls" presented to the Society in 1917, I ventured two predictions. One was that the great preponderance of submarine construction was in the vicinity of 800-ton vessels. This is well borne out by a study of the designs laid down during the war, some of which are still under construction. The other prediction was that the submarine itself is the best antidote for the submarine. Anyone who will analyze in detail the number of submarines lost in the war will find that, due consideration being given to the relative number of vessels engaged in anti-submarine warfare, the allied submarines accounted for more enemy submarines than any other type of vessel.

German Submarines

It was the writer's privilege to be detailed as a member of the Naval Allied Armistice Commission which proceeded to Germany in December, 1918, on board the H. M. S. *Hercules*. It also fell to my lot to be detailed as a member of the American Submarine Inspection Board which inspected German submarines after their surrender at Harwich, England. A casual inspection of about one hundred submarines and a detailed inspection of one vessel of each type were made.

All modern German submarines are of the double-hull type. The war produced three standard types of German submarines which are known as the UC type, the UB type and the U boat or "mittel U-boat." In addition to the standard types, there were two special types, as follows: UE type, mine-laying cruisers; UA type, large cruiser class. The large cruiser class consists of two designs, the ordinary design being a vessel of about 2,000 tons surface displacement, while there were a few of the special cruiser design of about 1,200 tons surface displacement. There were apparently only two vessels in this class completed, and they were especially designed for surface speed.

The UC class is made up of small, coastal, mine-laying submarines. This class has a surface displacement of about 500 tons and a submerged displacement of about 575 tons. These vessels in their latest development are about 185 feet long, 18 feet beam, and 12 feet draft. They made about 11½ to 12 knots on the surface and 6 to 7½ knots submerged. The mines were carried in the forward part of the vessel in non-watertight compartments or mine wells, 18 mines being usually carried, although some of the designs carried only 12. A torpedo tube was fitted in the stern and two torpedo tubes were fitted externally in the superstructure, sometimes forward and sometimes abaft the conning-tower. They usually carried one 10.5 or one 8.8-cm. gun. There were about 100 of these boats completed and a great many more in the course of construction.

The UB class of vessels formed the coastal submarines and were vessels of about 520 tons surface displacement and 650 tons submerged. They were 183 feet long, 19 feet beam and 12 feet draft. They had a surface speed of about 13½ knots and a submerged speed of 7½ to 8 knots. Four torpedo tubes were installed in the bow and one in the stern. They usually carried one 10.5-cm. gun; no mines were carried on the UB class.

It is of particular interest to note that the UB class and the UC class in the final analysis were very similar in size and displacement. An examination of the boats of these classes in Germany in December, 1918, showed very completely the progressive steps made in the design and construction of these types of vessels. The earlier UB boats and the UC boats only displaced about 125 to 150 tons each. It was very soon demonstrated that these boats were too small for the purpose intended and when standardization took place it resulted in boats as indicated above. There were about 140 UB boats completed and many more under construction at the time the armistice was signed.

U-boat—"Mittel U-boats."—The first boat of this class was completed in 1906 and had a surface displacement of 238 tons. The increase in the size of this type of submarine continued through various progressive stages until 1914, when the displacement had reached about 760 tons. The "mittel U-boats" subsequent to this date were generally similar in design except that the displacement increased slightly so that the latest type had a surface displacement of about 830 tons. The standard design of "mittel U-boats" has about the following characteristics:

Surface displacement	830 tons.
Submerged displacement	1,030 tons.
Length	235 feet.
Beam	20½ feet.
Draft	12½ feet.

Designed surface speed, about 16 knots.
Actual surface speed, about 15 knots.
Designed submerged speed, about 8½ knots.
Actual submerged speed, about 8 knots or less.

Most of the "mittel U-boats" were fitted with four bow torpedo tubes and two stern torpedo tubes. They carried either one or two 4.1-inch guns. This type of boat was considered the most successful of the German submarines, and many of the German service consider that, if they had adhered to this type of vessel, they would have been more successful in their submarine warfare. The Germans had completed at the time of the armistice about 110 of these vessels; a large number were also under construction in various parts of Germany.

UE Class.—These were large ocean-going mine-laying cruisers of:

Surface displacement	about 1,200 tons.
Submerged displacement	1,520 tons.
Length	275 feet.
Beam	24 feet.
Draft	13 feet.

Designed surface speed, 14.7 knots.
Designed submerged speed, 7.2 knots.
Armament, 4 bow torpedo tubes; 2 stern *mine* tubes, 39 inches in diameter.

Stowage space was available for 42 mines and 24 torpedoes. It is doubtful whether these vessels carried this number of spares. Their gun armament consisted of one 5.9-inch gun and one 4.1-inch, although in some cases they may have carried two 5.9-inch guns. Usually only one gun was carried.

There were about 10 of this class completed and a large number building. U-71-80 were small mine-laying submarines of this general type but of an earlier design, and only displaced about 760 tons. They were not a successful design.

Cruiser Class—UA Type.—Of the special cruiser class there appear to have been completed only 2 boats—U-135 and 136. Their displacement is similar to the mine-laying cruiser class, that is:

Surface displacement	1,200 tons.
Submerged displacement	1,535 tons.
Length	275 feet.
Beam	24½ feet.
Draft	13 feet.
Designed surface speed	18 knots.
Designed submerged speed	8.2 knots.

They had 4 bow tubes and 2 stern tubes and carried one 5.9-inch gun.

The large cruiser class consisted of vessels of the following characteristics:

Surface displacement	about 2,000 tons.
Submerged displacement	2,500 tons.
Length	302 feet.
Beam	29½ feet.
Draft	17 feet.

They carried 4 bow tubes, 2 stern tubes and 19 torpedoes. They had a designed surface speed of 15.8 knots and a designed submerged speed of 7.7 knots. Only four of these boats were actually completed at the time of the armistice, but there were a large number under construction in various parts of Germany.

After describing in detail various features in the design of these vessels the author enumerates the outstanding important features as follows: Excellent engines, excellent periscopes, double-hull protection, large surface radius of action.

A few of the objectionable features and defects are briefly enumerated in the following:

1. No effort made to insulate auxiliaries.
2. Apparently little effort made to eliminate noise of auxiliaries.
3. Elaborate ventilation and cross connections.
4. Elaborate air purifying installations. Altogether too elaborate.
5. Superabundance of shafting running from control room.
6. Bulkheads penetrated by myriads of leads of all kinds.
7. Only one hatch in U. C. conning tower—an element of weakness.
8. Batteries are inaccessible except in UE and UA classes.
9. Folding wireless masts—heavy, awkward, and cumbersome installation.
10. Many emergency leads and connections of all kinds. Altogether too many.
11. Much space given up to officers' quarters and C. P. O.'s; not much space or comfort for crews.
12. Little attention paid to hull excrescences.
13. Submerged speed considered of minor importance.
14. Boats are not well designed as to exterior of hull, so far as speed is concerned, either surface or submerged.
15. With the horsepower the engines give, greater speeds should and could be obtained.
16. Boats are crowded, congested, complicated and filled with "Gadgets" of all kinds.
17. There is a good deal of doubt about the stability of the mine-laying cruisers, and the large cruisers, particularly submerged stability. Ample evidence was obtained to show that the Germans considered this a very serious question with regard to these boats and various modifications and alterations were under way to improve the stability of these designs.

Discussion

President Capps remarked that at the 1898 meeting of the society, when reference was made to the future utility of the torpedo boat and submarine, little did the members realize that in a future war period of two years more than 15,000,000 tons of shipping would be lost due to the activity of the submarine. The submarine certainly has a place now and in the future. It is just as interesting to note that the torpedo boat, which has evolved into the torpedo boat destroyer, has been one of the greatest factors in bringing the submarine warfare to a close in the last months of the war. The great number of destroyers that were produced, their speed, maneuvering qualities and the ability to carry quantities of high explosive served to bring about this desirable end. It almost seems that the end of the big surface battleship is at hand unless the proposed League of Nations eliminates the submarine as the future weapon of war.

FRIDAY MORNING SESSION

The Propulsive Efficiency of Single Screw Cargo Ships

BY COMMANDER WILLIAM M'ENTEE, U. S. N.

(This paper is published on page 796)

Discussion

Alfred J. C. Robertson stated that in Commander McEntee's work of last year a ship having a parallel middle body near the bow was tested, giving the horsepower needed by the ship and the resistance that had to be overcome. With a blunt bow and full stern the greatest propeller efficiency was obtained at a speed of about 6 knots. As the speeds become higher the parallel middle body is moved aft in order that the wave-making resistance and the wake factor shall balance each other.

An increase of 3 percent resistance has been noticed in the changes of this year's model. A vessel having a prismatic coefficient of .80 would be rather full forward for good efficiency. If the fullness were aft, a coefficient of .70 would result. An ordinary ship of good proportions with a coefficient of .61 should give the best results. About 5 percent of the effective horsepower of the model should be added to the shaft horsepower of the full-sized ship as computed from the model to overcome the resistance of the bilges and the wind-making resistance.

It would be interesting, stated W. L. R. Emmet, to compare the series of tests conducted by the General Electric Company's men on a tank steamer. Data were compiled from readings made on a torsion device which

connected the shaft to the propeller by means of a system of springs and twist amplifying devices. With the apparatus a complete record of stresses in the shaft under working conditions in all kinds of weather were possible.

Turbine speeds were computed from the torque and under a 4-degree pitch of the vessel the torque nearly doubled, indicating that a load was thrown on to the propelling machinery. The propeller was at all times submerged so that the stresses were due to the speed of the propeller and the water. The maximum effect was not due to cavitation but occurred when the propeller was settling into the sea at which time the speed of the water traveling by the ship's side was reduced somewhat. There is no doubt that this action has been responsible for the destruction of turbine gears.

These observations would tend to indicate that a propeller having a large area has the least slip when turning at slow speed. This type would be efficient in rough water while a small high-speed propeller would be most efficient in smooth water.

Buoyancy and Stability of Troop Transports

BY PROFESSOR WILLIAM HOVGAARD

(This paper will be published in an early issue.)

Discussion

W. H. Mackay remarked that when ships were turned over to the Department for conversion into troop transports, it was not possible to make stability calculations. The lines for the ships were not available and it was not convenient to carry out inclining experiments. It was vitally important, however, that the maximum live load should be known and the deadweight ballast necessary to allow for troop carrying.

In the case of the *Leviathan,* it was decided that on her first voyage it would be safe to carry 7,500 troops, 500 officers and 1,500 men in the crew. Anti-rolling tanks were only used during the time this vessel was in service as a transport. It was determined after the first voyage that 12,500 troops could be carried safely and the Navy personnel could be increased to 2,500 men. Later this number was increased by two or three thousand troops.

Rear Admiral D. W. Taylor, U. S. N., chief constructor of the United States Navy, pointed out that to the naval architect of the present day, given the plans of a ship, the position of her center of gravity, and plenty of time, solutions of questions of buoyancy and stability are easy, but that in the stress of the war as a usual thing there were no plans, and no time. A former German vessel between 500 and 600 feet was to be fitted at a yard to carry the maximum number of troops, this vessel must sail the moment she was fitted, and in the meantime the damage done the machinery by her former owners had to be made good. Three things were done as a rule:

First.—Structural additions helpful to buoyancy and stability that could be completed within the time and with the facilities available were made.

Second.—Holes were cut in longitudinal bulkheads to render it reasonably certain that if a transport were sunk by a submarine she would not first capsize.

Third.—Fixed ballast was added as necessary, such that, combined with the available water ballast, acceptable metacentric heights were obtained as explained in the paper.

It was recognized that it was not practicable, without inadmissible delay, to bring up the transports to the plane of safety against torpedo attack of a battleship, and that the main responsibility for safety of our transports rested upon our destroyers and other convoying vessels. These gave a very thorough illustration of Farragut's maxim, that the best defense is a vigorous offense, and no eastbound troop-laden transport convoyed by our Navy was touched by a torpedo. The *President Lincoln,* westbound, was hit by three torpedoes, rendering her sinking inevitable, but she did not capsize. Neither did the *Covington,* which remained afloat a night and the better part of the day after being torpedoed. The *Mount Vernon* was hit at about the worst possible place, at the worst possible time—so far as loss of life was concerned—just as watches were being changed. She returned safely to port, as did the *Finland.*

The Application of Standardization and Graphical Methods to the Design of Cylindrical Return Tubular Boilers

BY HENRY C. E. MEYER

(This paper will be published in an early issue.)

Discussion

E. A. Stevens stated that ships' boilers have been ruined by crowding in too many tubes in order to increase heating surface. After getting scaled the heating surface is decreased unless steps are taken to clean between the tubes properly.

In reply to a request as to the pitch determination for use in the paper, H. C. E. Meyer stated that pitch was based on the standard distance between tubes of one inch vertically and 1¼ inches horizontally. Instances have occurred in which to increase the heating surfaces pitch distances of only $\frac{13}{16}$-inch and ½-inch have been used but the practice is to be condemned both from the viewpoint of circulation and cleaning.

The weight curves for boilers and for water have been based on values taken from 300 different boilers and these weights are correct within one or two percent.

There is a great deal in favor, as was brought out in the discussion, of spacing tubes 7 inches to 9 inches apart over the center of the furnace instead of 3½ inches. A better circulation will result from this spacing.

New Developments in High Vacuum Apparatus

BY G. L. E. KOTHNY

Abstract

The adoption of the steam turbine for marine propulsion has brought about many changes in marine engineering, which have become necessary in order to fully realize the many economical advantages obtainable. These changes affected particularly the vacuum producing apparatus. Steam turbines require the highest possible vacuum for highest efficiency and economy. The importance of this has been realized, and considerable research work has been carried out and many developments have been made in relation to the condensation of steam and the extraction of air. In this paper the author records some developments which have been made during the last few years in the extraction of air from marine condensers, with special reference to the development of the steam air ejector.

After briefly indicating the principles of operation, as well as the most important factors in steam air ejector design, several types of ejectors are described which have been in successful operation in marine condenser installations over two years and thereby have proved their fitness for marine service. Only two types in a variety of sizes have so far been used in a large fleet of merchant marine and navy vessels. These are known as the "Radojet" and the Le Blanc air ejector. Both are of the two-stage type, the stages being connected in series.

Until the appearance on the market of the steam air ejector the twin-beam air pump quite monopolized the

field, therefore the author gives a comparison of the two types. Considering first the comparative steam consumptions based on equal air and condensate handling capacity the author claims that the steam consumption of the air ejector, plus that of a turbine-driven condensate pump, is lower than that of the twin-beam air pump, even if the latter is arranged with a dry and a wet cylinder. The weight and space requirements are also decisively in favor of the air ejector outfit.

Other comparative advantages of the air ejector enumerated by the author are:

It has no moving parts nor valves, does not require lubrication, nor attendance during operation.

Its operation is noiseless, simple and reliable.

No foundations are required and no restriction as to location exists. It is to all intents and purposes a piece of pipe.

Since there are no moving parts there is no wear, and consequently the maintenance costs are practically nil.

When using a steam-air ejector the feed water carries less absorbed air into the boilers than when using a twin-beam pump. The condensate pump forms a self-contained unit. All the attention it requires is to see that its ring oiling bearings are kept filled with oil. The discharge head of the condensate pump is not limited, as is the case with the twin-beam air pump. Since it operates independently from the air ejector the pump has greater flexibility and can easily take care of large amounts of condensate without influencing the air-handling capacity. This is not possible, it is claimed, with the twin-beam air pump, in which the air-handling capacity is limited by the piston speed and simultaneously by the amount of condensate removed.

When using air ejectors and condensate pumps a considerable saving in weight and cost of piping can be made because the pipe sizes are smaller, as much higher velocities are permissable when dealing with water and air separately.

Steam-air condensers are generally supplied in pairs for marine condenser installations, this subdivision having the advantage of reducing the steam consumption by operating with one under light loads or when the installation is air tight, also of providing additional capacity in case of unexpected leakage. In larger installations sometimes three or even four air ejectors working in parallel are being used with two condensate pumps.

This subdivision also gives an absolute assurance against a total shut-down, which might occur when using a single reciprocating type air pump.

In concluding the author points out that the steam-air ejector was first tried out on board a ship about four years ago. It was feared that, by discharging the commingled steam and air into the feed tank, the amount of air absorbed by the feed water would be greater than that when using a reciprocating piston air pump. Comparative tests have shown that this fear was groundless.

The amount of air absorbed in the feed water, when using the ejector, was 35 percent less than that when using the twin-beam air pump.

With this obstacle removed, the air ejector rapidly gained the confidence of shipbuilders and marine engineers, so that there are today, according to the author's knowledge, over five hundred ships built in this country equipped with steam-air ejectors. About one-third of these have been in successful operation for periods up to two years.

From this it would appear that the steam-air ejector today occupies a position among the air pumps similar to that occupied by the steam turbine among steam-operated prime movers. Its advantages, reliability and simplicity, are dominating factors which, in the author's opinion, will gradually make its adoption as universal as that of the steam turbine.

Discussion

M. L. Katzenstein: In many ways the paper is interesting and I agree fully with many features in the discussion of the operation of the ejector itself. In other respects the paper is misleading and in some instances quite incorrect.

The development of the marine condensing unit has not kept pace with stationary practice. With full appreciation of the modifying conditions, I see no reason why, as stated on page 1, the limit for marine condenser performance should be placed at 1½ inches for 60 degrees, or 2 inches for 70 degrees, whereas a stationary plant is designed for and readily maintains 1¾ inches and in some cases 1½ inches with 70 degrees, the latter corresponding to a saving of 2½ to 3 percent in the steam consumption of the main turbine.

On page 2 reference is made to air leakage and Plate 1 gives curves stated to show "*permissable* air leakage for marine surface condensers," which would be very interesting if correct and authoritative. Recent estimates on the smaller sizes show allowances which run from 50 to 100 percent greater than shown on Plate 1.

The separate wet and dry system referred to by the author has been used by the Worthington Company for many years in stationary practice and has been extended to include vertical marine pumps of the twin type. The steam ejector has the important advantage for marine work of reduced space and weight, but many disadvantages and complications. The battleships, cruisers and destroyers of the United States Navy were equipped with the twinplex type of pump (upwards of 400 during this period for destroyers alone) and in a few cases where the ejector was installed by the Navy, it was only as an auxiliary or in conjunction with a pump of the twinplex type.

The statement is made that a steam ejector with a turbine-driven condensate pump will require less steam than a twin-beam air pump or even the twinplex pump with the wet and dry cylinder. This is absolutely incorrect and from actual tests we find that the twinplex pump will take only about 40 to 45 percent of the steam required by the ejector and condensate pump, operating at the same capacities. The efficiency of the twinplex pump is much greater than that of the twin pump and it covers the requirements of the separate wet and dry vacuum system.

There is another most important feature in connection with Plate 2. When the non-condensible vapors leave the condenser to enter the steam ejector, they are seldom cooled more than 10—perhaps 15—degrees below the temperature corresponding to the vacuum, but where an hydraulic vacuum pump is used, the vapors are reduced to the temperature of the circulating water. Where a steam ejector carrying 2 inches absolute in service receives the vapors cooled to say, 90 degrees, the hydraulic vacuum pump or rotative dry vacuum pump would handle vapors cooled to or saturated to 70 degrees, which would occupy approximately only 46 percent of the volume of the vapors going to the steam ejector, so that the steam ejector does 2.16 times as much work as it would if its vapors were cooled to the same temperature.

As to the mechanical efficiency of the ejector, at a recent convention, figures were submitted showing that the amount of useful work performed by the steam ejector represented in B. T. U.'s only .003 of 1 percent of the total evaporative heat of the steam delivered to the main

turbine. This also gives some index of the efficiency of the steam ejector.

The author states that the steam required by the non-condensing ejector will be reduced 30 to 40 percent by the condensing ejector. The Worthington ejector tests show a reduction of approximately 50 percent. It will be found that the percentage of steam saved by using the condensing type of ejector is a very large factor and not to be argued down without a careful study of the heat balance.

The statement is made that the amount of air absorbed by the feed water, when the ejector is used, is 35 percent of that when the twin-beam air pump is used. The twin-beam air pump has been practically superseded in the latest installations by the twinplex or wet and dry pump. It is not believed that actual tests will show any increase over the ejector in the air absorption by the feed. This, however, would be to some extent modified by the design of heater and whether the exhaust is passed into the body of the feed or through a falling spray.

With regard to the weights, figuring upon the same quantity of air in both cases, the twinplex runs from 2 to 2½ times greater weight than the non-condensing ejectors with turbine driven condensate pumps, not approximately 7 to 1 as stated in the paper. In the case of many cargo vessels, the items of space and weight are not of prime importance.

It must be remembered also that the steam ejector, on account of lack of elasticity, must be installed in multiple units and I would like especially to impress upon the members the fact that the vacuum pump handles air and not steam and the old basis of attempting to rate pumps upon the quantity of steam handled must, before long, give way to an intelligent selection of size based upon the quantity of air used.

A statement should have been made in this paper, declared E. H. B. Anderson, of the valuable work in connection with the steam air ejector or augmentor which was done by Sir Charles Parsons in 1903 and 1904. The type which he developed at that time has been used in connection with all Parsons' turbines in the United States Navy.

In a recent turbine installation, the designers did not make sufficient allowance for the water drainage but when it came to the operation the condenser pipe was blanked off and an ejector used instead to take care of the drainage. While maneuvering at slow speed, this means was quite adequate to eliminate water from the turbine, but when driving ahead at cruising speed the ejector did not take care of the drainage. Three bad breaks in the turbines resulted. This matter of drainage is a very essential item in the proper operation of turbine drive. A separate condensate pump, or a separate ejector should be fitted low down in the drainage line. The steam consumption required of the pump or the ejector should be taken care of in computing the operating efficiency of the system.

The mechanical efficiency of the ejector is very low, being a fraction of a percent, but the thermal efficiency is extremely high, for only a very small amount of heat is lost in its operation, the greater amount of heat being returned to the feed water.

Launching of Ships in Restricted Waters

BY CAPTAIN H. M. GLEASON, CONSTRUCTION CORPS, U. S. N., AND LIEUTENANT COMMANDER H. E. SAUNDERS, CONSTRUCTION CORPS, U. S. N.

(This paper will be published in an early issue.)

Professor William Hovgaard related instances as far back as 1895 in which ships being launched under his supervision in Denmark were allowed but a thousand feet in which to be brought under control. At this time there were no previous data on launching ships in restricted waters and, necessarily, a rough estimate was made. The ships in question were launched successfully and the data compiled at that time served for the future information of those responsible for launchings at this one place.

When the scout cruiser *Chester* was launched in Fore river, rope stops were used as well as two friction brakes to check her down the ways. The friction brakes were nothing but wooden wedges sliding between planks. Unfortunately, the upper part of the brakes splintered and the effect was lost.

The application of stern masks in launching a ship is always a good practice, for it probably has more effect than any other method so far used to check a vessel. The application of the data compiled in this paper from model experiments is to be commended, for it is the first information that has been applied scientifically to this very important question.

FRIDAY AFTERNOON SESSION

The Propelling Machinery of the U. S. S. Leviathan

BY ERNEST H. B. ANDERSON

(This paper will be published in an early issue.)

Discussion

A record of some of the personal experiences on the *Leviathan* when she was being put into condition for transport service were given by W. H. McKay. No information up to the reading of this paper has been released on the difficulties encountered in getting the ship ready for use. When she was turned over to the Shipping Board, there were no fires on board and no lights. All drawings and plans of the ship and her machinery, piping and the like, had either been destroyed or were almost illegible, so there was practically nothing aboard to use as a basis in tracing out the various systems.

American and British engineers went ahead with the work, however, and, in three months and 12 days, had steam up. The problem of rebuilding the turbines, supposedly wrecked by the German engineers, was solved by the Westinghouse and General Electric companies, as well as the Coe Brass Works, of New Britain, Conn. Men from the Westinghouse and General Electric Works went immediately to New York to install blades that were turned out by the Coe company, which shut down commercial production for two weeks in order to supply the blades in time. All necessary tools were made by the Brooklyn Navy Yard under Captain Jessup's supervision. The German chief engineer made the statement before leaving the vessel that the Allies would never be able to run her. In the one and one-half trips which he had made about four stages in one of the low pressure astern turbines had been wrecked. The tips of the blades on the first four rows of the last stage came very close to the casing and it is probable that under the very slight expansion, when steam was admitted, they rubbed against the casing. The heat generated in this way caused a distortion in the blades which aggravated the trouble and finally put the wheel out of commission. The trouble occurred where the blades were longest and most easily distorted.

In trying to find the trouble, the Germans had cut a 16-inch path through part of the blading at various points, but had never found out where the trouble really

was. The trouble started in the first row and extended to the fourth, but, after this stage, none of the blades had been wrecked.

The *Leviathan* could not have used her backing turbines but she was probably good for 80,000 or 90,000 horsepower when going ahead. If it had been necessary to put in new casings for the turbines, the repairs would have taken six months. Fortunately, with the new blading installed, no trouble was experienced after the ship was put in commission.

The damage was not due to faulty installation, as has been suggested, but rather to faulty personnel.

There is no question but that the speed shown by the repair crews on various Germam ships being converted into transports was responsible in a great measure for the happy termination of the war.

Standard Lubricating Oil Systems For Geared Turbines

BY EMILE SCHMELTZER AND B. C. FERNALD

(This paper will be published in an early issue.)

DISCUSSION

C. R. Waller stated that until four years ago very little was known about the new vessels in America and Europe equipped with geared turbines. In 1906 a geared turbine ship in Vancouver was fitted with an oiling system of pipes having elbows and 45-degree angles arranged in a complicated network. The pump to take care of this system would have had to overcome a resistance equivalent to a 24-foot lift. Naturally a pump of this capacity was not installed and troubles with the oiling system were of constant occurrence.

Another instance occurred in which the engineers wished to install a gravity tank but the expense involved was not thought necessary. On the trial trip of this ship it was necessary to shut down the power six times in order to pump oil. The pressure operating valve would not work and the trouble could not be found. In the case of the gravity tank, it is always possible to tell on inspection whether the supply is getting low or not and whether there is trouble in the system.

One great necessity in any system is to keep the oil free of salt water. It is possible to lubricate machinery with oil and water but it is almost impossible to feed oil and water through any system. In the case of gears, salt water is very harmful, for even in a day or two they become covered with rust.

It has been the habit when turbines or gears in merchant ships have given trouble to blame the manufacturers but this paper will serve to educate turbine users that a correct oil system is necessary to proper operation.

Electric Propulsion of Merchant Ships

BY W. L. R. EMMET

(This paper is printed on page 814.)

DISCUSSION

E. A. Stevens, Jr., declared that the statement, that "in the case of warships the electric drive activities have been uninterrupted," is only true of warships built in this country and of a certain class.

Regarding the arrangement shown on Plate 1, it is very questionable whether there is very much space saved. The amount of room taken by the motor in the stern would be very close to that saved in the engine room; besides, there is no provision shown for ventilation of the motor room. I have been informed by the chief engineer of the Federal Shipbuilding Company that upon investigation it was found that this means of propulsion required more room and was heavier and more expensive than either the geared turbine or the reciprocating engine for the class of ships built by this firm. The generator being placed above the boilers, as shown, would be very impractical for four reasons. First, the space above the boilers would be very cramped. Second, the engine room would be considerably hotter. Third, the auxiliaries would be on a different level from the operating platform, which is very undesirable. Fourth, the difficulty of providing proper foundations for the turbine and gears. Very few engineers if any would care to go to sea in charge of an electrically propelled vessel, without means of communication between the motor and engine room.

On the second page, last paragraph, it is stated that the motor would be self-lubricating and only occasional inspection would be necessary. I would consider it very risky to leave this compartment with only occasional inspection, for if any trouble occurred it would very likely be between inspections and might result in a general disability before it was discovered.

I do not believe that any greater economy can be obtained with the electric propulsion than with the geared turbine. If it is advisable to use electric-driven auxiliaries, which I doubt very much, there is no reason why this type should not be used with the geared turbine outfit and the same economy be obtained.

Regarding reliability, I can see no advantage in the arrangement suggested in this paper for operating vessels with the main generating unit out of service, by having a motor generator set or rotary converter arranged so that the power of the auxiliary generators could be delivered to the main motor. This would be quite expensive for a piece of machinery that would be lying idle most of the time; besides, the auxiliary generators would have to be considerably larger than what would be necessary for operating the auxiliaries. As far as reliability is concerned, the reciprocating engine is as good as any. With the geared turbine of the cross compound type, reliability is assured without carrying any spare machinery.

It is stated that the efficiency of the generator is 95.6 and the motor 95.9, making a transmission efficiency of 91.6, including cable losses. If this be true, the cable losses must be zero.

Regarding the operating force, it is stated, "Conductor circuits are much simpler mechanically than pipes and mechanical motions, etc." This might be considered so by some people, but others think differently. Steam leaks are much easier to locate and repair than short circuits or electric leaks, and steam-driven auxiliaries are easier to repair than those driven by electricity; furthermore, the former is less likely to be damaged by water than the latter.

Parker M. Robinson pointed out that the generator efficiencies given in the paper, of 95 percent and 94.7 percent, are correct but the actual circumstances under which the efficiencies were determined are not given. In one case, with an oil of a medium viscosity, an efficiency of 94.2 percent was obtained, but with the same combination and a low viscosity oil, efficiencies as high as 97.5 percent have been obtained.

John C. Reid, in referring to a previous statement, that it might be possible to obtain good results with Diesel oil, engine-driven generators, said an attempt had been made a number of years ago on the Great Lakes to connect a 750-horsepower Diesel plant to generators on a 250-foot vessel. The electrical apparatus worked perfectly but, because the Diesel engine had no overload factor, the system developed an effective horsepower of only 600. The generator and the Diesel acted in opposition to each other and the Diesel never came up to power.

There would seem to be very little choice between the electric drive and the geared turbine drive, either from cost of installation, upkeep or efficiency.

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National Merchant Marine Association's Shipping Policy

THE council of the National Merchant Marine Association at a meeting recently held in Washington unanimously adopted resolutions calling on Congress to enact legislation for the prompt sale of Government-owned vessels. The association recommends that vessels of under 6,000 tons deadweight be sold with privilege of transfer of flag, and that the larger ships be sold to American individuals and firms only. It is also recommended that the entire fleet be sold within a period of two years.

It was the unanimous opinion of the council that the Shipping Board should be directed to dispose of the entire Government fleet, including the vessels obtained from Germany and those in the process of construction, and that purchasers of the larger vessels, whose sale is restricted to Americans, should be required to pay 25 percent cash, the balance of the purchase price to be met by deferred payments over a period of ten or fifteen years, these deferred payments to bear five percent interest, secured by first mortgages.

The resolutions provide further that, after a sale of a portion of the larger vessels, the unsold remainder shall be allocated by the Shipping Board, as far as practicable, to those who have purchased, on the basis of payment of a commission to the operating firms or corporations and payment by the operators of the proportion of the consolidated net earnings of the ships owned by the operators and the Government-owned tonnage which the operated tonnage bears to the total tonnage operated by such firms or corporations.

The association also recommends that those who purchase and operate ships in the foreign trade under this plan shall be exempt, in respect to the earnings of the ships, from all Federal excess profit taxes for a period of from ten to fifteen years, provided they be permitted to charge off ten percent of the net earnings of the ships on account of depreciation and deduct such amount in their tax returns as operating expenses. The amount of the earnings equivalent to the excess profit tax that would be payable is to be invested in new tonnage from American shipyards.

Finally Congress is called upon to enact special legislation to assist existing passenger lines in the construction and operation of new passenger tonnage of the highest class and latest design and type and to inaugurate and develop additional passenger and freight lines on routes which it is desirable, in the national interest, that direct passenger and freight service should be established.

The association will take immediate steps to bring its programme to the attention of Congress and the country. The House committee on merchant marine and fisheries has completed its hearings and reported favorably on the Greene bill, the provisions of which are outlined elsewhere in this issue, but the association will appoint a special committee to appear before the Senate committee on commerce in support of Senator Ramsdell's bill.

American Insurance and Classification

"TO MAKE our merchant marine a success, we must have our own American insurance and classification" was the keynote of the speech delivered by Homer L. Ferguson at the annual banquet of the American Society of Naval Architects and Marine Engineers, held at the Waldorf-Astoria on the night of November 15. Mr. Ferguson's entire speech was given the rapt attention of the thousand and more members and guests, representing to a larger extent than ever before the various elements entering into the building and operating of the American merchant marine.

The speaker, on account of his long experience as head of one of our leading shipyards and his present position as the president of the United States Chamber of Commerce, can speak authoritatively on all matters pertaining to our merchant marine and foreign trade generally, hence his sentiments above quoted should be given the most serious attention of all patriotic American citizens.

There is among us, unfortunately, a large class of men in important positions in the merchant marine, who, from lack of proper consideration, ultra-conservativeness or alien leanings, are not taking this warning to heart. Many new ships are being contracted for by private parties, and, unfortunate to relate, are being classed with alien societies, notwithstanding the fact that we now have a live, energetic and efficient classification society of our own. This society, representing as it does the best American talent in shipbuilding and underwriting, has thrived during the late war and has "classed" over 70 percent of the enormous tonnage turned out in American yards. To keep up its position and to enable it to retain its progressive efficiency it must have the unqualified confidence and patronage of all loyal Americans. The United States government has in every manner possible given its support without stint, and has signified its intention in every legitimate manner of continuing to back up this most important function of a merchant marine. Citizens should do as well in this respect as their governmental representatives.

A Merchant Marine Referendum

THE Chamber of Commerce of the United States has submitted to the 1,236 organizations which form its membership a report of its committee on ocean transportation embodying recommendations for the disposition of the two thousand or more merchant vessels which the Shipping Board now possesses, or has under contract. As the vote of these organizations will determine the attitude of the National Chamber of Commerce on one of the most important questions that will come before this session of Congress, these recommendations deserve careful consideration. They are as follows:

1. That wooden vessels, and steel vessels under 6,000 tons deadweight, be sold on the best terms obtainable from American or foreign bidders.

2. That other government-owned vessels be sold to regional associations for transfer at cost to private individuals and corporations of the several regions.

3. That the government absorb the difference between the war cost and the present value, as a war loss.

4. That there be freedom from regulation as to routes and rates.

5. That there be restriction for a period of years upon transfer to a foreign flag of steel vessels over 6,000 tons deadweight purchased from the government.

6. That preference be shown for American underwriters, and that the underwriting market of the world be used for insurance not covered by American underwriters, without intervention by government insurance.

7. That encouragement be given to an American classification society.

8. That Congress be asked to make a general declaration of a policy to give aid toward the maintenance of a privately owned and operated American merchant marine.

9. That the operation of the competent American shipbuilding yards, on private account both as to yards and the vessels they construct, be continued.

With one exception these recommendations are in accord with the best judgment of the majority of shipping men as expressed in recent months. They are based upon sound patriotic principles and should receive the endorsement of the commercial interests throughout the country. If carried out, they mean an end of government ownership, and the establishment of a definite policy of government aid towards the maintenance of a privately owned and operated American merchant marine, insured and classed by American interests.

The one exception is the second recommendation which limits the sale of government-owned vessels of over 6,000 tons to proposed regional associations for transfer at cost to private individuals or corporations in their respective districts. While the formation of such associations would undoubtedly serve a good purpose in stimulating public and local interest in the upbuilding of an American merchant marine, nevertheless to delay the sale of ships until such regional associations are formed and purchasers found in these regions would probably mean a long continuation of government control and operation, which in itself would defeat one of the principal aims of these recommendations.

The sooner the American merchant marine is in private hands, the better. The sale of vessels above 6,000 tons should be effected as quickly as possible to any American individuals, firms or corporations, wherever located, that can meet the terms offered. Vessels do not operate solely from home ports, but go wherever business offers. The distribution of tonnage will adjust itself as the ports have business and terminal facilities to offer.

Wages for Crews on American and British Vessels

AS a comparison of monthly expenses for wages of officers and crews on American and British vessels, Emil P. Albrecht, president of the Philadelphia Bourse, gives figures for a class C American ship of 7,000 tons deadweight and a British ship of 7,500 tons deadweight. For the British vessel a bonus of £3 is included in addition to the regular wages, £1 being figured as $5. The figures are summed up in the following table:

	American Ship Coal-fired Scotch Boilers		American Ship Oil-fired Watertube Boilers		British Ship Coal-fired Scotch Boilers	
	No. of Men	Monthly Wages	No. of Men	Monthly Wages	No. of Men	Monthly Wages
Deck.....	18	$2,097.50	16	$1,947.50	16	$1,535.00
Engine Room....	24	2,677.50	16	2,027.50	20	1,760.00
Stewards.....	8	690.00	6	555.00	6	382.50
TOTAL.....	50	$5,465.00	38	$4,530.00	42	$3,677.50

From these figures it is seen that in the case of an American ship fitted with oil-burning watertube boilers there is a decrease of 12 men, or 25 percent, over a similar ship fitted with coal-burning Scotch boilers, and a decrease of $935, or 17 percent, in monthly wages. On the other hand a British coal-burning vessel as compared with an American coal-fired vessel takes 8 less men, or a reduction of 16 percent, and shows a decrease of $1,787.50, or 33 percent, in monthly wages. A British coal burner as compared with an American oil burner takes 4 more men in the engine room, or an increase of 10 percent, but shows a decrease in monthly wages of $852.50, or 19 percent. In other words it costs 48 percent more, as far as the wages of the crew are concerned, to operate an American coal burner than a British coal burner, and 23 percent more to operate an American oil burner than a British coal burner.

On British vessels four licensed engineers are not obligatory. If two licensed engineers are on board, the other two may be machinists. Comparing the American and British coal-burning vessels, it is seen that in the deck department the British vessel requires two less men and 20 percent less wages, in the engine department the British vessel requires four less men and 26 percent less wages and in the steward's department the British vessel has the advantage of two less men and 44 percent less wages.

LETTERS TO THE EDITOR

Crude Oil Motors in Marine Practice

Editor Marine Engineering:

The writer notes in the October issue the article, "Crude Oil Motors versus Steam Engines in Marine Practice." In the summing up of the article the author speaks of crude oil motors of various types, and it is noted that in all of the engines mentioned there is no reference whatever made to an American engine of this type. All of the two cycle engines mentioned in this article are copies of the Mietz oil engines, and if references are to be made in such articles, the writer believes it would be only fair that some mention should be made of motors of standing, and particularly an engine that is the pioneer of its type. In fact there are several makes of engines mentioned in this article which the writer believes have a very limited reputation, and he further doubts very much whether half of these machines are even known to the engineers familiar with this class of machinery.

New York. J. T. O'CONNELL,
August Mietz Corporation.

Lake System of Dry Docks

Editor Marine Engineering:

I am interested to note the article by John Lake in the letters from marine engineers in your October issue. The system of dry docks mentioned may be new, but from a practical standpoint it would be too expensive to install and operate.

If the dry docks are located at sea level, it is self evident that any movement of water from one basin to the other must be done eventually at the expense of pumping. Otherwise, Mr. Lake will have developed a method of perpetual motion. If one lock is to be unwatered by releasing the water to lower level chambers, those chambers must at some time have been pumped out of an equivalent amount of water. The loss due to leakage means that more power would be required to do the same work. Also, the disadvantage would extend to the utilizing of a multiple of basins, causing interference and interdependence, which, added to the decreased efficiency, makes the scheme impractical.

Providence, R. I. F. W. ERICKSON,
Vice-President and General Manager, Marine Engineering & Dry Dock Co. of R. I.

Lubricating Systems for Geared Turbines

Editor Marine Engineering:

Your editorial in the September issue on the subject of "Lubricating Systems for Geared Turbines" is timely and very interesting.

The writer has had considerable to do recently with the furnishing of oil filtering equipment for the lubricating systems of vessels being constructed for the Emergency Fleet Corporation. On something like 300 to 400 turbine driven vessels, which are being fitted with Peterson marine type of oil filter, manufactured by the Richardson-Phenix Company, the lubricating systems are laid out practically along the lines mentioned in your editorial.

However, we wish to make strenuous objection to your statement that the filter used in an oiling system is a danger, in that it may become choked and interrupt service.

The Peterson marine type filter, which is strictly a low pressure or "gravity" filter, is so designed that in event of it being entirely neglected (a remote possibility) the oil will automatically overflow the filtering compartment and the circulation of oil will not in any way whatsoever be interrupted.

Large numbers of these systems using Peterson marine type filters have been in successful operation on vessels constructed by practically every prominent shipbuilder in this countrty, and therefore I believe that your statement in regard to filters being a possible source of danger in the line of a circulating system should be refuted.

New York. EDWIN M. MAY.

A Belated Tribute to Noah and His Nautilus

Editor Marine Engineering:

During the July rainy season when shut-in vacationists were censuring Jupiter Pluvius, St. Swithin and the Weather Man, and water courses of hitherto regular habits and staid respectability were disregarding traffic regulations and ruthlessly disarranging the adjacent scenery along their banks, the timely suggestion was made that the world's greatest shipyard at Hog Island should become a National Institution for the building of Noah's arks. The threatened distress from the flooding of houses could thus be avoided and the perplexing question, "What should be done with Hog Island?" would be satisfactorily solved.

The house boat type of abode has for centuries past relieved congestion in Asiatic and some European countries, where the surplus population continually exceeds the housing accommodations, and there is an apparent need in this country for an improved type of river tenement or community boat to house the unfortunate homeless. The maintenance of a floating population by adapting the ark idea to 20th century requirements recalls to mind the remarkable achievements of shipbuilder Noah, the original apostle of preparedness, the chosen preserver of the human race and the patron life saver of the animal kingdom.

According to archaeological records of the ancient Chaldeans and Egyptians, which are more or less fragmentary and largely traditional, the Great Deluge is supposed to have occurred 38,460 years ago, or 36,541 B. C. Whether this prehistoric date is the correct period of antiquity or inaccurate by several milleniums, the fact still remains that the construction in a primitive era of a seaworthy craft, capable of housing and rationing for a full calendar year a restless menagerie of birds, beasts and insects, was an engineering and zoological feat that was more than marvelous.

This first wooden ship was a three story affair, 450 feet long (or the length of a modern city block), 75 feet wide and 45 feet high with a central side door. The construction details are omitted in the *Exodus* version, so we can only conjecture as to whether the side door was high enough to serve all three decks or whether inclined planes, hatchways or ladders provided access between levels. The single upper window, which was one cubit or 18 inches deep, was no doubt a continuous series of openings to permit of light and ventilation. The use of carrier birds to determine when the flood had subsided seemed to indicate that the high window could not be used for observation purposes.

Considering the primitive methods and meager facilities in this antediluvian age it is not surprising that Noah was six hundred years old before he was able to finish and equip the ark. We have no idea how many years or decades the building operation required, but are inclined

to suspect that the mural hieroglyphics must have included the original versions of such patience and perseverance mottoes as, "It is never too late to begin," "Haste makes waste," "Never start anything you can't finish," etc.

When the pioneer shipbuilder began his life work and was subjected to the abuse and ridicule of the knockers in "his own home town," he must have experienced greater mental and physical anguish than our own skeptical civilization with the added aid of the public press, movie pictures and expert criticism inflicts on the modern inventor (the so-called crank?) who has the courage of his convictions. Granting that Noah used rule-of-thumb methods in building the ark to withstand the external elements and internal occupants, the rounding up of the birds, beasts, and bugs, the selection and capturing of the choice specimens, the stocking and preserving of universal rations and the regular feeding of the pets and prisoners must have been a herculean task for the strenuous Noah family. Such problems as the fresh water supply, sanitation, group segregation and policing the ark must have required expert veterinary skill and constant labor to avoid menacing the general health of the inmates and prevent jungle habits disrupting the otherwise happy cruise of the good ship *Ark*.

As we review in retrospect how Noah carried out his divine instructions and successfully accomplished the seemingly impossible feat of saving the human race from extinction, we are prone to wonder why conserved humanity in some past era in the world's history failed to express its gratitude by erecting a more fitting memorial to Mr. Noah than the little toy arks which are eventually wrecked in juvenile nurseries. H. T. MOORE.

Launching Experiment

Editor Marine Engineering:

During several recent side launchings on the lakes the drop was so great and the angle of heel was so pronounced that it was decided to try a few experiments to ascertain the correct angle of heel and the number of rolls it took a "canal sized" vessel to come to rest upon being launched under ordinary conditions. The accompanying

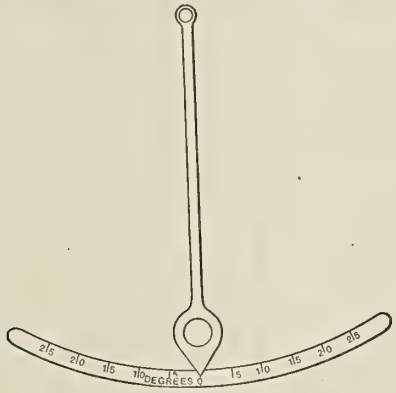


Fig. 1.—The "Tell-Tale"

plates with a short description will serve to illustrate the method used.

On the after end of the engine casing, above the bridge deck, was hung a "tell-tale" consisting of a brass pendulum (Fig. 1) that would swing with the roll of the boat. A brass arc was arranged in connection with the pendulum, being divided into degrees, and a man as stationed at each side of the instrument who marked the angle of heel as the ship rolled.

LAUNCHING EXPERIMENT NO. 1

Name———————. Place—A Great Lakes Yard.
Hull E. F. C.—1836. Time—August 13, 1919, 7 A. M.
Dimensions—Length, 261 feet over all; 251 feet between perpendiculars; beam, 43 feet 6 inches; depth, 28 feet 2 inches.
Launching Draft—Forward, 4 feet 9 inches; aft, 7 feet 11 inches; mean, 6 feet 4 inches; displacement, 1290 tons.
Coefficients at above Draft—Block, .663; prism, .69; midship, .963.
Depth of Water—16 feet 5 inches; width of slip, 102 feet; length of ways, 40 feet.
Pitch of Ways—1½ inches = 1 foot.
Distance dropped from end of Ways to Water—39 inches.
Time from first roll to rest—35 seconds.
Density of Water—Fresh.
Center of Gravity above Base—16.9 feet.
Metacenter above Base—26.6 feet.
Metacentric Height—9.7 feet.
Angle of Heel—25 degrees.

LAUNCHING EXPERIMENT NO. 2

Name———————. Place—A Great Lakes Yard.
Hull E. F. C.—1837. Time—August 30, 1919, 7 A. M.
Dimensions—Length, 261 feet over all; 251 feet between perpendiculars; beam, 43 feet 6 inches; depth, 28 feet 2 inches.
Launching Draft—Forward, 4 feet 6 inches; aft, 8 feet 2 inches; mean, 6 feet 4 inches; displacement, 1290 tons.
Coefficients at above Draft—Block, .663; prism, .69; midship, .963.
Depth of Water—16 feet 1 inch; width of slip, 102 feet; length of ways, 42 feet.
Pitch of Ways—1½ inches = 1 foot.
Distance dropped from end of Ways to Water—43 inches.
Time from first roll to rest—35 seconds.
Density of Water—Fresh.
Center of Gravity above Base—16.9 feet.
Metacenter above Base—26.6 feet.
Metacentric Height—9.7 feet.
Angle of Heel—20 degrees.

The experiments were tried on the same type of boat and in the same slip. The displacement of both boats was the same, the drop being greater in the case of the second boat. The angle of heel was less in the boat with the greater drop. At a later date we hope to try similar experiments on boats with different coefficients.

J. L. GOBLE, Chief Draftsman,
Toledo, O. Toledo Shipbuilding Company.

The Reciprocating Man

O, woesome oor' that saw the birth
O' turbine thochts in Pairson's heid,
I wish that I was aff the earth,
Or else the turbine mon was deid.

I'm a receeprocatin' mon,
I love to hear the bearing bump,
Or yet, the piston groan and grunt,
That's relegated tae a pump.

This Whirligeein' thing I hate,
Fur whatna gude is it tae dea?
Tae see the fearsome thing gyrate
Gars me puir stummick gang aglee.

I widna care if it had ocht
Tae need a tender fitter's haund,
But it rins' sae weel sin it wis bocht
I havna had to slack a glaund.

I hate the tribe o' whirligegs,
It's jist a pinch o' steam, then "Scat."
I'm a receeprocatin' mon,
I stan' or fa' wi' Jeemie Watt.

—"WEE JAMIE."

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Main Engine Feed Pump Defect

In a certain ship installation the main feed pumps were driven direct from the pump levers and the hot well overflow pipe was led down the front of the main condenser, so that it could be observed from the starting platform by the engineer on watch. While the ship was under way, it was sometimes noticed that the precious feed water trickled from the pipe and went to waste in the bilges. Several times this trickle became a serious

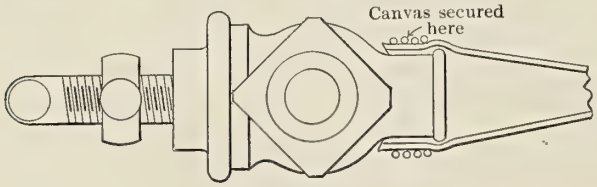


Fig. 1

overflow, necessitating the use of the auxiliary feed pump to assist in getting rid of the excess water in the hot well. In this case the pet valves had to be screwed down to the limit of safety, in the endeavor to obtain the highest pumping efficiency.

It was found that an excellent automatic petting device, Fig. 1, could be obtained by simply fixing a short length of canvas, about 3 inches long, to the pet cock. When wet, this worked like a charm and gave the minimum amount of air cushioning, at the same time prevent-

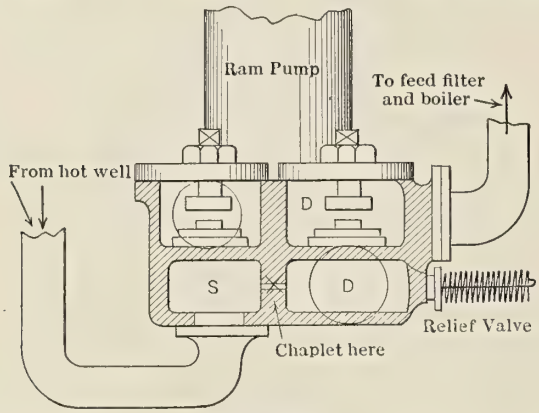


Fig. 2

ing slogging of the water in the pump and the consequent shock to the pump and feed pipe range. The trouble was very intermittent—sometimes continuing for a watch but in several instances for days.

Long runs at sea were the order for this packet, but when the opportunity came in port to investigate the trouble, the pumps and valves were put through an exhaustive examination and readjustment. The hot well, air vessel cover was raised ½ inch to allow better exit for the air and vapor from the feed water, but to no avail. For nearly a year no apparent cause for the leak could be found.

One day, however, while the suction and delivery valves on the feed pumps were being overhauled, a piece of slack metal was discovered projecting from the wall of the delivery chest. This eventually proved to be the head of a loose chaplet nail, Fig. 2, the body of which was quite slack in the wall of the delivery box. When the flat head of the nail was clear of the chest, the worn orifice had allowed an almost continuous leakage of feed water under boiler pressure to the suction side of the pump. The feed water thus accumulated in the hot well till it obstructed the free exit of the vapor delivered by the air pump. Naturally, water was lost by way of the overflow pipe until the pressure was reduced sufficiently for the head of the nail to close up the aperture again.

With a suitable chisel the defective nail was, with difficulty, cut away and after fitting a suitable bolt with grommets and washers, our trouble from this source ceased.

W. I. E.

Wear of Crank-Pin

In advance of "dressing up" the low pressure crank-pin of a triple expansion marine engine, a certain curiosity was aroused as to amount and location of wear. Since a simple use of outside calipers would not give the desired results the method shown in outline by Fig. 1 was devised:

A straight-edge is clamped on two T-shaped arms which are pivoted at the centers of the pin. Adjusting screws are provided so that, by gaging from the slight projection of pin beyond the web, to the underside of

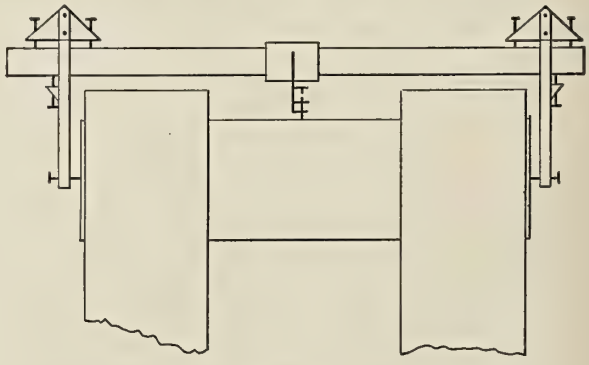


Fig. 1

bar, the straight-edge can be set parallel to the center-line of the pin. A sliding block on this bar carries a round pointed scriber, so arranged that it is free to move up and down a short distance. A light spring presses the point against the pin. Directly above the upper end of the scriber is a fixed screw with a ball point.

Now suppose the sliding block is set midway between the webs and the bar swung about its centers. The scriber point will follow the surface of the pin and any

deviation from a true circle will cause an up or down movement.

The amount of this motion can be measured by the use of "feelers" between the upper end of the scriber and the fixed point. If measurements be taken at a number of places in the circumference, we obtain figures which

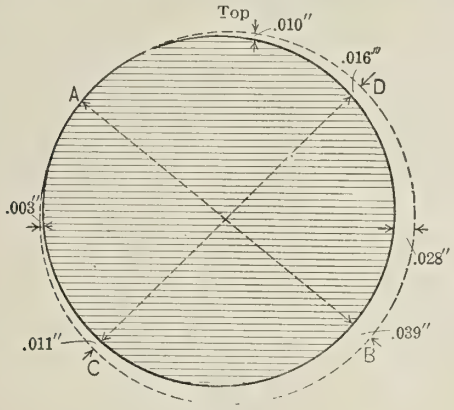


Fig. 2

may be used to plot a picture of the cross-section of the pin.

Fig. 2, showing the pin when the crank is on the top center, is the result obtained as a mean of several tests. The trueness of bar parallel to pin was checked in sev-

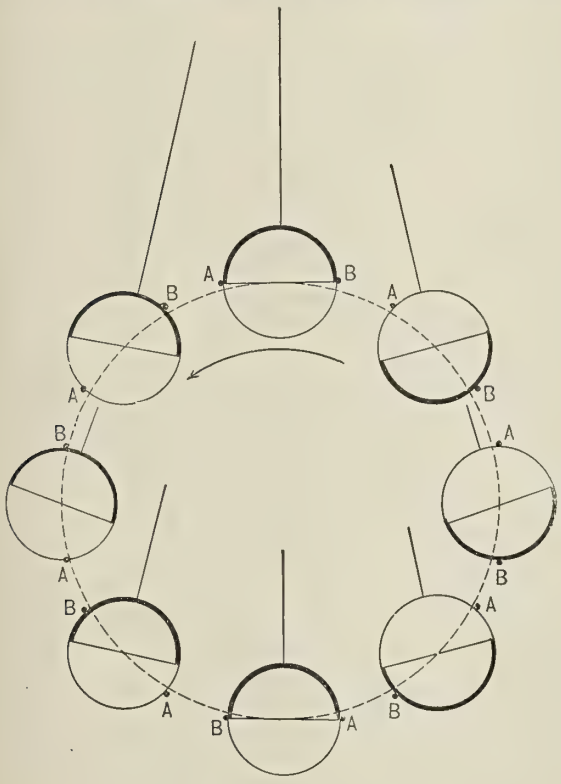


Fig. 3

eral positions and the figures are thought to be fairly accurate.

In any case, the interest is attached as much to the relative wear as to its precise amount. In our figure, which is not, of course, drawn to scale, we see the side *A* has worn the least, with a gradual increase in both directions toward *B*, where the wear is greatest.

A comparison of diameters shows *AB* is the smallest, being .039 inch less than the diameter of a circle through A, while *CD* is the greatest, being only .027 inch less than the circle diameter.

To "shape up" our pin to *AB* as a new true diameter will require filing heaviest at *C* and *D*—about .012 inch having to be removed. The same general result will be given by the use of a pair of calipers; but they would seem to indicate, by position of greatest diameter, that *C* and *D* were points of least wear. This is not the actual case, as our cross-section shows.

A point worthy of notice is that though the side *B* is worn badly and if the pin were to be trued up to the original center it would necessitate cutting a large amount of metal; at the same time, the pin is still fairly true relative to a center lying a little further over towards *A*. With the use of a semicircular face plate of a diameter *AB*, the pin could be faced up with only a reasonable amount of work, and to most any required degree of accuracy—dependent largely upon the patience of the operator.

In conclusion, Fig. 3 is submitted as showing clearly how the side *A* of our pin receives very little pressure at any time, while *B* receives the driving force on both up and down strokes. The pin is shown in different positions around the crank-circle; the heavily drawn semicircles indicating the half of pin which is, at the moment, receiving the pressure. A consideration of this diagram furnishes evidence as to the general correctness of Fig. 2.

The same apparatus of Fig. 1 was used also to measure the trueness of the surface of the pin in a fore and aft direction. It indicated, in this case, a number of ridges and grooves, ranging from a .006 inch to .010 inch variation from a straight line.

J. A. Rutan.

New York.

Repairs to Fractured Bilge Pump Barrel

Our engines were triple expansion and indicated about 2,000 horsepower when driving at our deepest draft. The bilge pump on the installation was driven from the air pump levers and requires no description other than that the ram was made of a hollow brass casting fitted to a spear or rod attachment, which connected it to the air pump crosshead.

I had just about completed my inspection of all the running parts, preparatory to taking the watch over from the third engineer, when, passing back of the main condenser, I noticed that the ram was fairly hot. On casting a glance at the tank top under the pump, a momentary gleam of burnished metal caused me to investigate further. To my surprise, I found the bottom half of the pump barrel broken off and lying on the tank top. The gleam was caused by the polished surface of the ram, as it reciprocated past the fractured end of the barrel. After easing the gland, I walked over to the third engineer, who by this time was standing by the exit ladder of the engine room, and asked him how the bilge pumps had been working. When he saw what had happened, he recalled the fact that about half an hour previously he had heard a heavy thump, but had not been able to locate the cause.

As there were two bilge pumps on the engine, we stopped the main engines, after a consultation with the chief, and drew the plunger of the defective pump. The cause of fracture was found to be a ¾-inch iron hexagonal nut which had presumably been allowed to fall to the bottom of the barrel when at some previous overhauling the neck bushing was being drawn for renewal. This carelessness was attributed to some shore fitter, as it was highly improbable that any of the ship's staff would be

guilty of such gross negligence. The nut showed signs on its faces of contact with the bottom of the ram. These marks were old, but evidently the accident had been brought about by the nut becoming tilted onto one of its faces, as this indication was confirmed by the appearance of the nut.

The following day we got the ship's carpenter to fashion a box, Fig. 1, and after coating the broken edges of the barrel with paint, the broken part was shored in place and liquid cement run into the box until it was filled. In

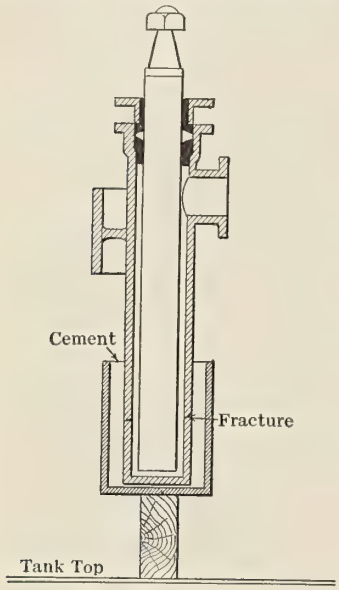


Fig. 1.—Temporary Repair at Sea

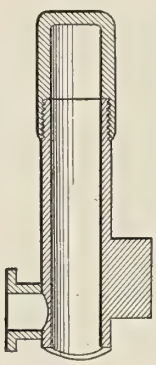


Fig. 2.—Showing Permanent Repair to Bilge Pump

a very short time the whole had set solid, and on stopping the main engines once more and refitting the ram, we were delighted to find that the repair was, as the chief said, "as good as gold."

We were bound from Newport News to Gravesend with cattle on our shelter deck and our holds full of grain. After discharging the cattle at Gravesend, we proceeded to Antwerp to discharge our cargo of grain. At the latter port mechanical repairs were effected, but I confess I was somewhat loth to see the cemented repair cut away, as it was as solid as a rock. In Antwerp (before the war, of course) the pump barrel was put in the lathe and a suitable extension made by simply threading the external surface of the barrel, as shown in Fig. 2.

W. I. E.

Disabled Piston of Quadruple Expansion Engine

The steamer on which the writer had the following experience was a twin-engined vessel, having quadruple expansion engines working at 225 pounds boiler pressure. The engines were balanced on the Yarrow-Schlick-Tweedy system and ran, as the saying is, "like a clock." We were bound from London to the Antipodes and were about a month on our way, with everything running well, when it became apparent to the watch engineers that some slight trouble was afoot in the first intermediate pressure cylinder of the port engine. A slight click was faintly audible. As the piston swept to and fro, the sound could only be discerned when one was standing by that cylinder on the top grating. The matter was noted for investigation, when we arrived at our destination, Melbourne, as it was not considered urgent enough for stopping the engine at sea.

On arriving at our destination, the piston and valve, as well as the metallic packing of the piston rod, were thoroughly overhauled, without giving any satisfactory result as to locating the origin of the sound. Curiously enough, after overhauling all this gear, while we were engaged on the coastal run, the sound was not apparent and of course the matter was dismissed from our minds as of no importance. Finally the day of departure for the return voyage came round and on my first watch homeward bound I was exasperated to note that the telltale sound was once more in evidence. Before my watch was over—we were just 12 hours on our 12,000-mile voyage—I was electrified by a resounding crash from the port first intermediate pressure cylinder. Just one crash and the engines seemed to run as before. I ran up to the port intermediate pressure cylinder and found the piston rod beginning to heat up. A second glance revealed the fact that it was running a little out of alinement. While I stood critically watching the swiftly moving rod, the piston commenced to grunt in the cylinder, so that I hardly had time to rush to the stop valve to stop the engines before they began to slow down of their own accord.

After stopping, the intermediate pressure cylinder cover was lifted, revealing three or four pieces of more or less crushed cast iron. A look underneath the cylinder cover showed that one of the core plugs had slackened back sufficiently to come in contact with the piston, when it had dropped out and jammed between the piston and cover. The piston rod was bent at the juncture with the piston, and the junk ring fractured in two places.

It was considered expedient to open up the piston valve also for examination, and very fortunate it was that this was done, as about a cubic inch of the fractured plug had been expelled through the upper steam port and was found lying on top of this valve.

In order that effective repairs could be made, which would take some days, it was decided to draw the piston rings, close up the cylinder and get under way again, allowing the steam to pass through the cylinder and do what little work was required to actuate the connecting rod, without being a drag on the engines. This worked out all right and so we carried on with some little diminution in speed. In about four or five days we were ready to replace the readjusted rings, which consisted of a muntz metal ring placed under the bull ring in order to bring the piston rings fair with the bore of the cylinder again and to set them up the exact amount that they were out of alinement. The piston rod was allowed to run, being fitted with metallic packing, which allowed a fair amount of side play to the rod and kept the gland moderately steam tight without undue heating.

The junk ring was considered safe though fractured and after all was assembled the engines ran very well almost normal again.

There are generally two sides to a question of any sort, and of course two sides to a cylinder cover, a fact sometimes overlooked by the rising generation of seagoing engineers when overhauling the engines. The covers are lifted and safely stowed aside to allow an inspection of the cylinders, pistons, etc., but I have never yet observed any of the juniors examining the underside for possible defects. If perusal of the above tends to inculcate more care in this particular matter, the writer will feel that his experience has not been without some good to his profession.

W. I. E.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsman and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Approximate I. H. P. Formula for Reciprocating Engine

Q. (1026).—Is there any formula that will figure approximately the correct horsepower of a steam reciprocating engine, if the sizes of the high, intermediate, low pressure cylinders and stroke are known? If not, any other formula with the Revolutions Per Minute and other more complicated figures, data and parts of the machinery outfit known will be appreciated.

A. (1026).—There are several formulas which give the indicated horsepower approximately. The one below, which is from the "Guidance Specifications for Reciprocating Expansion Marine Engines," compiled by the North East Coast Institution of Engineers and Shipbuilders, is simple and will hold for ordinary triple expansion reciprocating engines installed in cargo steamers.

$$I.\ H.\ P. = \frac{D^2\ SN}{700}$$

D = Diameter of low pressure cylinder, in inches.
S = Stroke, in feet.
N = Revolutions per minute.

Seaton & Rounthwaite's "Pocket Book of Marine Engineering Rules and Tables" gives some additional formulas.

Power Formula for Motor Boat

Q. (1027).—How and why does the coefficient c in the speed formula $V = \frac{c\sqrt[3]{L \times B.\ H.\ P.}}{\text{Beam}}$ quoted in the September issue of MARINE ENGINEERING vary with change of form? N. M. S.

A. (1027).—A short, wide boat at ordinary speed will require more power than a boat which is long and narrow and the formula should take this into account. For a fuller discussion of this formula see article by H. H. W. Keith in *Motor Boating* for June, 1911, or "Propellers," by C. H. Peabody, page 28. In Keith's method, from which the following is taken:

$$V = \frac{C\sqrt[3]{L \times B.\ H.\ P.}}{B}$$ (Keith's Formula.)

L = Length over all, in feet.
B = Extreme beam, in feet.
$B.\ H.\ P.$ = Brake horsepower.

Type of Boat	Ratio L ÷ B	Values of C Miles	Knots
Cruiser	3 to 5	9 to 11	8 to 9.5
Runabout	5 to 7	8 to 10	7 to 8.5
High Speed		8 to 9	7 to 8

values of C can be obtained by using data from existing launches.

It should be noted that the formula is wrongly stated in the September issue of MARINE ENGINEERING.

Weight of Paint

Q. (1029).—Please publish an approximate formula for estimating the weight of painting to be allowed for in estimating the weights of a new design. C. A. S.

A. (1029).—The estimated weight of paint for design work is usually based upon the weight of bare steel hull. Cement is often included with the paint in making such an estimate. The writer has no definite figures at hand on this subject, but would figure that in the ordinary cargo steamer cement and paint would together equal about 2 percent of weight of the bare steel hull.

Angle of Roll

Q. (1030).—A ship 29 feet depth and 49 feet beam at a load draft of 20 feet, rolls 45 degrees; what would be the immersed section of deck, if any, at this relative angle of the ship to the sea level? What is commonly known to be the greatest angle a ship can roll and right itself? Is there any record of any ship's having rolled 90 degrees and righted itself? L. C. H.

A. (1030).—Your problem cannot be fully solved without more data, since a vessel's deck ordinarily has a sheer fore and aft, also tumble-home is common. It is necessary also to know the bilge radius as well as the deck camber.

If the above dimensions were applied to a flush decked, straight sided, square ended barge, the distance her deck would go under when tipped to an angle of 45 degrees can be easily calculated, and would be about 19.3 feet. In rolling waves are set up the effect of which on the angle of succeeding rolls is hard to predict.

The British navy, since the disaster of the *Capitan,* has recorded the rolling of its war vessels. The maximum roll recorded in Sir William White's "Naval Architecture" is 36 degrees from the vertical.

In the press lately there have been pictures of side launchings of some of the Lake type steamers. One, the *Lake Fugard,* according to reports, rolled 72 degrees from the vertical. The writer knows of no authentic case of a steam vessel rolling to this extent in a storm and still retaining steam. I do not doubt, however, that some light sailing vessels and yachts have rolled to this extent or even 90 degrees, and have not capsized, although records of this do not seem to have been published. The self-righting lifeboat, of course, and many keel yachts are unstable when bottom up.

Corrections to Answers in the September Issue

In answer (1018) to the question concerning "Engine and Propeller for Motor Boat," published in the September issue, Keith's formula should read:

$$V = \frac{\sqrt[3]{L \times B.\ H.\ P.}}{\text{Beam}}$$

The propeller should be 22 inches by 22 inches, instead of 22 inches diameter by 82 inches pitch, as stated.

In the sketch of relieving tackle in answer (1019) the line connecting the two tackles which passes from port to starboard quarter block was omitted. The line, of course, is continuous from the starboard quarter block through the starboard and port tackles and through block *A* till it is fastened to the small tackle or jig used to take up the slack.

The British Admiralty has revealed that during the entire course of the war Great Britain lost 2,479 merchant ships, aggregating 7,759,000 gross tons, through enemy action.

Shipbuilding and General Marine News

Contracts for New Ships — Shipyard Improvements — Engineering Projects—Improved Appliances—Personal Items

AMERICAN SHIPYARDS PRODUCE 4,258,000 GROSS TONS IN PAST YEAR

Figures Show An Increase of 1,977,934 Tons Over Output in Preceding Year

During the twelve months ending November 1, 1919, American shipyards turned out 2,395 vessels of 4,258,000 gross tons, officially numbered by the Bureau of Navigation of the Department of Commerce. Though a small tonnage built for foreigners is included, nearly all the tonnage represents the expenditure of Treasury funds for shipbuilding.

The figures included in this statement show the shipbuilding activities in one year, or since the signing of the armistice. In the twelve months preceding the first of November, 1918, the corresponding output was 2,280,111 gross tons, part of which represents private investments in ships.

Lloyd's Register for 1918=1919 Shows Increase In Shipping

The annual report of Lloyd's Register of Shipping has been renewed, and the 1918-1919 report, together with a review of work done by the society during the war, is now in circulation. The annual reports were curtailed and finally discontinued because of the restrictions on shipping information during the war.

The report states that "at the end of June, 1919, there was being built under the inspection of Lloyd's Register of Shipping with a view to classification a larger amount of shipping than has ever been recorded in the history of the society, namely, 4,766,623 tons." Statistics show that in the last five years the society classed nearly 10,000,000 tons of new shipping.

In June, 1916, an American committee was established, and Lloyd surveyors reported on construction of vessels in the United States as follows: 1917, 107 vessels of 482,778 tons; 1918, 239 vessels of 945,912 tons; 1919, 470 vessels of 1,883,-759 tons. "At a later date," the report states, "there were 419 vessels of 1,787,-803 tons under construction in the United States with a view of classification with Lloyd's Register."

General Electric Absorbs American Marconi Company

The Radio Corporation of America has been formed with the backing of the General Electric Company to absorb the American Marconi Company, dependent upon the approval of the stockholders of the latter concern. The General Electric Company will contribute $2,500,000 to the Radio Corporation, part of which capital will be used in buying American Marconi shares held by the British Company.

Secretary Daniels Opposes Re=peal of Charleston Dry Dock Appropriation

An attempt to repeal the appropriations for constructing a dry dock at the Navy Yard, Charleston, S. C., large enough to accommodate the biggest battleship of the Navy, as well as a channel of corresponding depth, was recently disapproved by Secretary Daniels, in a statement before the Senate naval affairs committee.

The discussion brought out the fact that the projected dry dock was absolutely essential to the proper development and maintenance of the Navy. The strategical importance of providing dry dock facilities for vessels in the south Atlantic was given great emphasis by naval experts. The Charleston navy yard offers the only suitable point south of Cape Hatteras for the construction of a dock that will accommodate large vessels. Three docks are being used at present on the Atlantic coast, at Portsmouth, N. H., Boston, Mass., and Philadelphia, Pa. The addition of the dock at Charleston would complete the programme for dock construction on the east coast.

Leviathan Allocated to the American Line

Announcement that the United States steamship *Leviathan* will be turned over to the International Mercantile Marine has been made by the Division of Operations of the United States Shipping Board. P. A. S. Franklin, president of the company, has long expressed a desire to obtain this vessel for use in service between this country and northern Europe.

The extensive changes which are necessary to convert the *Leviathan* from a troop transport to commercial uses and also to change her from a coal to oil-burning vessel, make it probable that she will not be ready to sail again for a number of months. It is estimated from the experience in reconditioning smaller vessels that about six months will be required for the work.

FUTURE SHIPPING POLICY PROPOSED BY SENATOR JONES

Legislation to Suspend Operations of the Emergency Fleet Corporation

Senator Jones, of Washington, has introduced two bills, one of which provides for the disposition or operation of merchant vessels of the United States, to stimulate interstate and foreign commerce, to encourage the development of the merchant marine of the United States (S. 3355), and one to create the United States Merchant Marine Corporation, and to sustain and build up the merchant marine of the United States (S. 3356).

In introducing these bills, Senator Jones stated that about 8,000,000 of the 12,000,000 tons of shipping in the foreign trade under the American flag should be Government-owned. In the discussion Senator Jones said: "We may differ about Government ownership but that cannot be made an issue at present. The Government owns nearly all the ships operating in foreign trade at present and we must not allow private parties to take the cream of this shipping and let the Government hold the balance to dispose of at a great sacrifice. It is granted that Government ownership should end as soon as possible but it must be brought about without unnecessary sacrifice. No one can reasonably hope that private enterprise and capital in the face of foreign competition and handicapped by our own experience, will be able to absorb and take over all this shipping in a short while."

Senator Jones also contended that unless private capital can take over the plant constructed by the Government at Camden, N. J., and now operated through the New York Shipbuilding Corporation, it should be retained and used for the construction of large ships for which there are no other facilities.

MERCHANT MARINE CORPORATION

In explanation of his bill to create a merchant marine corporation, under Government control; to operate the Government fleet for not more than thirty years, but without competing with private, established lines, Senator Jones said in conclusion:

"We now have the United States Shipping Board acting in a dual capacity. It was intended to be a great, regulatory, governmental agency, and is, in fact, doing the work of a great corporation. It cannot well serve both ends. What I propose is to divorce the Shipping Board entirely from building, selling or operat-

ing ships and allow it to do the things it was created to do, and create a corporation, separate and independent of it, to operate, maintain and dispose of our ships in such a way as to give us an adequate merchant marine on a permanent basis."

The bill which Senator Jones said he would personally urge would abolish the Emergency Fleet Corporation, retain the present Shipping Board only in a supervisory capacity and create a new merchant marine corporation to operate government ships for thirty years, but not in competition with established private lines.

The alternative bill presented by the commerce committee chairman is a comprehensive measure "extending and superseding the present shipping board act and contemplating the inclusion of the duties and powers of the Shipping Board on all matters of operation, as at present."

Ultimate Private Ownership Favored

Ultimate private ownership of the Government's shipping property is favored by Senator Jones. The proposed merchant marine corporation, which would have no capital stock, would take over all the ships acquired by the Government during the war and all vessels and property in the hands of the Shipping Board and Emergency Fleet Corporation, for operation, sale, or other disposition with a view to maintaining a permanent American merchant marine. The new corporation would operate all government merchant tonnage and shipping property, while the Shipping Board would have a status similar to that which the Interstate Commerce Commission bears to the railroad carriers. The Shipping Board would have supervision over shipping rates and the Interstate Commerce Commission would be authorized, with the marine corporation, to require connections between rail and water carriers. Development of new shipping routes and lines for American shipping would be one of the principal functions of the Shipping Board.

The Jones bill declares for a Federal policy of having a merchant marine "sufficient to insure" American safety in emergencies and sufficient to carry the greater part of American commerce, together with ample shipbuilding and repair facilities, all ultimately to be owned by private parties and capital.

The proposed merchant marine corporation would be managed by nine directors, with headquarters at Philadelphia.

New Company to Build Raabe Oil Engines

The International Marine Construction Company has recently been incorporated under the laws of Delaware with a capitalization of $5,000,000. The officers and directors of the company are as follows: Robert Spiro, president; H. E A. Raabe, first vice-president; W. J. Bauer, second vice-president; H. E. Greene, secretary; W. A. Bischoff, treasurer; W. P. Morehouse and W. L. Harrison, directors.

The company, which has been formed for the production of Raabe oil engines, has established executive offices at 19-25 West 44th street, New York City. Special features of the Raabe heavy oil engine include the possibility of operation under an air pressure of fifty pounds per square inch with a start under full load without the use of auxiliary starting facilities. These engines are direct reversible, requiring neither clutch nor reversing propeller. The engines are also operated without air compressor or scavenging pumps. Variable speeds of any degree are permitted in both forward and reverse motion, thus providing the flexibility of the steam engine. These engines, the company claims, will operate on any grade of oil having sufficient hydro-carbon content to permit ignition.

New Machinery for S. S. Copan

Under the direction of Leonard B. Harris, naval architect, Woolworth building, New York, the *Copan* owned by the Cuyamel Fruit Company, New Orleans, La., is now being remodeled to double the ship's power. The present boilers, pumps, engines and auxiliaries will be removed, and two large boilers, 15 feet 6 inches in diameter and a triple expansion engine of 1,750 horsepower will be installed at the Harlan plant of the Bethlehem Shipbuilding Company, where the boilers and engines are being built.

Shipbuilding at the Chickasaw Yard

Four vessels known as design No. 2 are now being constructed at the yard of the Chickasaw Shipbuilding Company, Mobile, Ala. These vessels are similar to 30 vessels practically completed at the Kearny, N. J. yard of the Federal Shipbuilding Company, except that reciprocating engines are being used instead of turbines. Two of the vessels are fitted for oil burning and two for coal fuel, but all the vessels are arranged so that they may be easily converted to use either fuel. The vessels will develop a sea speed of 11 knots at 27-foot draft. The daily fuel consumption is estimated at 44 to 50 tons of coal and 32 to 35 tons of oil. Each ship is being equipped with ten 5-ton booms and one 30-ton boom to handle cargo from the four large holds by means of twelve steam winches.

The six vessels being constructed according to design No. 17 will be turbine driven. These vessels will develop a sea speed of twelve knots at 26-foot draft, with a daily fuel consumption of about 38 tons of oil. Two 5-ton booms, ten 8-ton booms and two 30-ton booms handle carge from five holds by means of 15 steam winches. These ten vessels are intended for service in the export trade of the United States Steel Products Company.

Contract Let for 9,600-Ton Vessel

The Bath Iron Works, Bath, Me., has received a contract for a 9,600-ton steamship from the Crowell & Thurlow Steamship Company, 131 State street, Boston, Mass.

Larger Naval Base at Mare Island Recommended

In a conference held between Secretary Daniels and a board of naval experts at Mare Island, Calif., recommendations were made to extend the facilities of the island so that it might be used as a greater naval base than at present.

It was suggested that there be provided at the south end of Mare Island, bordering on Carquinez straits, a berthing and docking station of two dry docks, berthing space with additional fleet storehouses; that the Pinole shoal channel be enlarged to a section of 500 feet in width and 40 feet depth at low water; that the present ammunition depot at Mare Island be removed to the north end of Mare Island, or to some other isolated location in San Francisco bay, accessible to tugs and ammunition barges; and that Congress be requested to approve the construction programme as laid down and create an apportionment of not less than $5,000,000 for the beginning of the work.

Plans for Thousand-foot Ship Cancelled

John Barton Payne, chairman of the United States Shipping Board, has announced the cancellation of all plans for the two 1,000-foot passenger ships, which were to have been built for the Shipping Board. Tentative plans for the vessels had been drawn and approved, so that construction could have been commenced almost immediately. The action suspending these vessels from the construction programme was taken in pursuance of the policy to eliminate all work not absolutely essential at this time.

Waterhouse Will Build $2,000,000 Pier at Seattle

The Frank Waterhouse Company, Seattle, Wash., has applied to the Seattle Port Commission for a permit to build a pier at the northwest section of the West Waterways. According to the plans submitted to the commission, the Waterhouse Company seeks to extend its property 155 feet on to the Railroad avenue waterway extension. If permission is granted for this construction, it is understood that the expenditure for the pier will be about $2,000,000.

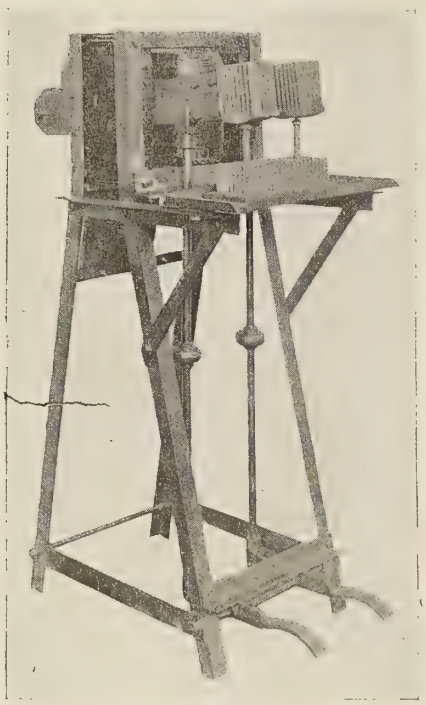
Current Prices Quoted for Ships Held by the Shipping Board

Quotations submitted by the United States Shipping Board for vessels of 7,800 tons built at Hog Island are $215 per ton. Other quotations include vessels of the *Frederickstadt* type of from 3,000 to 4,200 tons, such as were built on the Great Lakes, at $200 per ton, and 5,350-ton carriers, built by the Submarine Boat Corporation, at $210 per ton. The ships of the 8,800-ton size are quoted at $220 per ton, while the 10,000-ton products of the Skinner & Eddy yard on the Pacific coast are listed for sale at $225 per ton. Wooden vessels are being held for $90 per deadweight ton.

Electric Rivet Heating Device

An electric rivet heater has been placed on the market by the General Electric Company, Schenectady, N. Y.

The basis of the design is a transformer rated at 15 kilowatts mounted on angle iron legs, which may be fitted with wheels. At the front of the transformer, two copper bars are fitted with heavy, air cooled electrode blocks of cast copper, while under these is another copper block which acts as a support and as an electrical connection for two rivets in series. When the rivets are in place on the block, the electrodes are allowed to drop on the heads, thus completing the circuit and commencing the heating process. The two electrodes may be raised independently by two foot pedals, gravity being sufficient to lower the electrodes



Electric Rivet Heater

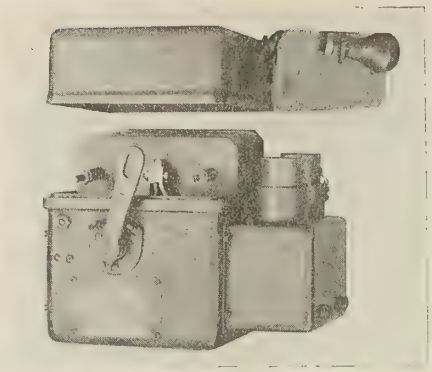
when the foot is removed. A primary tap switch mounted on the back legs of the machine gives all the variation needed for different lengths and diameters of rivets and rate of heating desired.

The sizes of heaters so far developed are a 5 kilowatt, two jaw for rivets up to ½ inch, and a 15 kilowatt, two jaw for rivets up to ⅞ inch.

Safety Starting Switch

Safety for the operator, safety for the motor and equipment and safety for itself are the three features embodied in a new type of starting switch for a small induction motor that is being put on the market by the Westinghouse Electric and Manufacturing Company. It is claimed that the switch is accident proof and well nigh fool proof.

The action of the switch is automatic and consists of strong springs attached to the contact parts and controlled by a



"Fool-Proof" Starting Switch

trigger. This trigger is released by overload, failure of power or by hand. When the switch passes the neutral point, the spring snaps it the rest of the way. The switch is shown in the accompanying illustration. Live parts are entirely enclosed in a dust-and-dirt-proof case.

When power leaves the equipment, a low voltage, protective relay releases the trigger and throws the switch. Upon the return of power, it is necessary for the operator to move the handle first to the reset position and then to the running position, before the motor can again be started.

Any undue overload causes the overload relay to release a trigger, which opens the switch as if the voltage failed. An overload throws out the switch and it must be reset before the motor can again be started.

Two sizes are made, each for use on two and three phase motors, with voltages up to 600. Type No. 815 starts motors of 10 horsepower or less, while Type No. 816 starts motors up to and including 25 horsepower.

PERSONALS

The following appointments have been made at the Newport News Dry Dock and Shipbuilding Company, Newport News, Va.: S. L. Wood, vice-president; C. E. Graham, treasurer; W. Gatewood, works manager; and H. F. Norton, naval architect.

J. Benton Porter, ship propulsion specialist, has been transferred from the Philadelphia office to the New York office of the General Electric Company, Equitable building, 120 Broadway, New York.

H. C. Higgins, formerly district manager, Emergency Fleet Corporation, at 301 South 10th street, Philadelphia, Pa., has become general manager of the Vulcan Iron Works, Jersey City, N. J.

Samuel B. Crosby has been appointed naval architect for the Newburgh Shipyards, to assume charge of the hull drafting room, the position left vacant by the departure of J. R. Preston for North Carolina.

Captain George L. Norton, editor of the *Marine Journal,* New York, has decided to retire from the active editorial management of the magazine, although he still will retain a financial interest in the publication. Winthrop L. Marvin, who has lately become secretary and manager of the American Steamship Association, and Winfield L. Thompson will act as editors.

The Mobile Shipbuilding Company, Mobile, Ala., has announced the resignation of Frank McLaughlin, formerly general manager. H. L. Brittain, president of the company, will be in direct charge of the plant until a successor to Mr. McLaughlin is named.

Robert McGregor, formerly general manager of the Federal Shipbuilding Corporation, Kearny, N. J., has been elected vice-president of the Green Star Steamship Company.

Captain Byron L. Reed has been placed in charge of the Coast Guard Service at the port of New York, succeeding Captain Godfrey L. Garden.

Major John Eldridge Cushing will succeed J. H. Rosseter as chief of the Division of Operations of the United States Shipping Board.

J. F. Andrews has succeeded L. A. Cholot as head of the European Trade Department of the United States Shipping Board.

John J. Flaherty has been appointed secretary of the Shipping Board and of the Emergency Fleet Corporation.

F. J. Tucker, assistant general manager of the Merchant Shipbuilding Corporation, Harriman, Pa., has been made general manager of the company's plant at Chester, Pa.

W. T. Wilson, works manager of the Harriman yard of the Merchant Shipbuilding Corporation, has been made assistant general manager. William Kennedy will succeed Mr. Wilson as works manager.

Professor Herbert C. Sadler, naval architect and consulting engineer of the United States Shipping Board, has resigned to resume his former work as professor of naval architecture and marine engineering at the University of Michigan. Mr. Sadler will also take up his general consulting practice again.

Arthur L. Busch, shipyard manager of the Bethlehem Shipbuilding Corporation, Ltd., Moore Plant, Elizabeth, N. J., has recently changed his name to Arthur L. du Busc. The new surname was the real family name of Mr. du Busc's French ancestors from the years 1315 to 1791. During the war, owing to the Germanism attached to the name of Busch, Mr. du Busc was inconvenienced. This experience prompted him to take legal action to change the spelling of his name.

Captain Felix Riesenberg, former commander of the New York Nautical School training ship, *Newport,* has succeeded Edward Frank Allen as editor of the National Marine, the monthly publication of the United States National Marine League.

A. R. Gilham, formerly with the St. John Dry Dock and Shipbuilding Company, New Brunswick, has been appointed managing director of the Canadian Vickers, Ltd.

Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIP CONTRACTS

The Atlantic Gulf & West Indies Steamship Lines, 11 Broadway, New York, it is reported, will spend $16,000,000 in tankers. Contracts for eight tankers have already been awarded to the following companies: the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.; the Sun Shipbuilding Company, Chester, Pa., and the Newport News Shipbuilding Company, Newport News, Va. These tankers were designed by Theodore E. Ferris, naval architect and marine engineer, 30 Church street, New York. Deliveries are to begin in 1921.

The Vacuum Oil Company, 61 Broadway, New York, has placed an order for one 10,000-ton oil tanker with the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., and it is also stated that the Pan-American Petroleum and Oil Company will order five ships of this type.

The New York Shipbuilding Corporation, Camden, N. J., has received a contract from W. R. Grace & Company, 7 Hanover Square, New York, to build a 10,000 deadweight ton tank steamer. The price for this ship is in excess of $200 per deadweight ton.

The Moore Shipbuilding Company, Oakland, Cal., will commence work on three 10,000-ton tankers, a contract which the United States Shipping Board has reinstated.

The Submarine Boat Corporation, Newark, N. J., has been awarded a contract for the fabrication of four 5,350-ton ships. These vessels are to be assembled at Palermo, Italy.

The McDougal-Duluth Shipbuilding Company, Duluth, Minn., has received a contract for two freighters from Norwegian ship owners.

The Shawmut Steamship Company, 60 Federal street, Boston, Mass., has placed an order for two 10,000-ton shelter deck, cargo steamers of 13 knots speed, with the Merchant Shipbuilding Corporation, Bristol, Pa.

The Alabama Dry Dock & Shipbuilding Company, Mobile, Ala., has been awarded a contract by the Texas Oil Company, 17 Battery Place, New York, to repair the ship *Edward Sewall,* damaged in the hurricane that swept the Texas coast September 13. The cost of the repairs will be approximately $90,000.

The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., is building six tankers for the Standard Oil Company, two at the Sparrows Point plant and four of 12,600 tons each at the Fore River plant.

The Federal Shipbuilding Company, Kearney, N. J., is building two vessels for the Freeport Texas Company, delivery of which has been promised early next year. One of these is a 50,000-barrel oil tanker and the other a 6,000-ton freighter.

The United States Shipping Board has opened negotiations with three of the large shipbuilding companies, for reinstatement of contracts for the construction of ten tank steamers suspended since the signing of the armistice. Negotiations are being conducted with the Bethlehem Shipbuilding Corporation, Ltd., for the construction of three tankers at the Alameda, Cal. yard, with the Baltimore Shipbuilding and Dry Dock Company for four at Baltimore, and with the Moore Shipbuilding Company at the Oakland, Cal. yard. The total tonnage involved is over 100,000.

Plate, Shapes and Bars for Tank Ships.—Two Pacific coast shipyards are inquiring for 20,000 to 40,000 tons of plate, shapes and bars for tank ships to be built there.

Ship for the Italian Government.—Italian shipbuilding companies have pledged themselves to supply 7,000,000 tons of new ships during the next two years and 1,000,000 tons the third year on condition that the Government promises not to change the maritime laws for at least fifteen years.

Two Battleships, Brooklyn, N. Y.—The keel for the battleship *South Dakota,* 42,000 tons, will be laid about January first at the Brooklyn Navy Yard and work on her sister ship, the *Indiana,* will be begun soon after. When completed these dreadnaughts will be the largest and most powerful of their type in the world. They will carry batteries of 16-inch guns, will be 666 feet long, use oil for fuel and be fitted with electric drive.

New Ships for French Line.—Contracts for the construction of 300,000 tons of new ships have been placed by the French Line with British and French shipyards, deliveries to begin next spring. In addition the French Minister of Marine has ordered ten cargo vessels and six liners to be built; the latter are for use in the Indo-China traffic.

Passenger Ships, Sparrows Point, Md.—The Emergency Fleet Corporation has altered its plans at the Sparrows Point yard of the Bethlehem Shipbuilding Corporation. Officials of that company have announced that the design for eight 10,000 deadweight ton transports has been changed so that they will be modern passenger ships. The passenger ships will be 535 feet long with a 72-foot beam and a 50-foot depth. Two hundred and fifty-three first class passengers and three hundred steerage passengers can be accommodated by the liners, which will have a large freight-carrying capacity. The work on these ships, which has been delayed for some time, owing to the change in design, will be speeded up.

Fleet of Merchant Vessels for the Argentine Government.—Dispatches from Spain announce that the Argentine Government is negotiating with the bank of Spain for a loan of $100,000,000 which will be used for the construction in Spanish shipyards of a large fleet of merchant vessels for Argentine.

Cancellations of the Emergency Fleet Corporation.—The Emergency Fleet Corporation has cancelled contracts with the American International Corporation for 23 troop and cargo ships which were to have been built at Hog Island and contracts with the Submarine Boat Corporation for 52 ships which were to have been built at Newark Bay. Aside from the action taken in the case of the vessels under construction at the yards of these companies, only 12 ships totaling 60,250 tons deadweight have been suspended from the active program of the Emergency Fleet Corporation. These suspensions include four ships at the Mobile Shipbuilding Company, Mobile, Ala., two at the Todd Dry Dock and Construction Corporation, Tacoma, Wash., three at the Manitowoc Shipbuilding Company, Manitowoc, Wis., two at the Toledo Shipbuilding Company, Toledo, O., and one at the Bayles Shipyard, Inc., Port Jefferson, N. Y. After these deductions, the program still calls for a merchant marine of 2,307 vessels aggregating 13,475,132 deadweight tons. The contemplated plan for building two 1,000-foot passenger vessels for the Emergency Fleet Corporation and for which tentative designs had already been drawn and approved, have been definitely cancelled. This cancellation ends any attempt that might be made in the immediate future for constructing large passenger vessels in American yards.

The Newburgh Shipyards, Newburgh, N. Y., since its organization has been building 9,000-ton cargo carriers for the Emergency Fleet Corporation. The contract with the Emergency Fleet Corporation called for twelve of these vessels. Three more are to be built before the contract is completed. The company has taken contracts for four vessels for private account. Two of these vessels will be equipped with geared turbines and oil burners. The keel of one of these, a 7,500-ton steamer for the Union Sulphur Company was laid on October 18. The other two steamers are for passenger service for the Cuyamel Steamship Company, New Orleans, La., and will have a deadweight capacity of 2,500 tons, and will be 330 feet long. These vessels have been designed by William Gardner.

The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., is repairing the steamship *Olean,* at its Wilmington, Del., plant. The *Olean* was sunk off the Spanish coast as a result of coming in contact with a German mine, which happened in December, 1918. The vessel remained under water for seven months, when the engineers raised the hull and towed it to Marseilles. The French Government repaired the vessel so that it could return to this country for reconditioning.

The William Cramp & Sons Company, Philadelphia, Pa., has been awarded a contract to make extensive repairs to the Lighthouse tender *Columbine* of the Baltimore district, at a cost of $50,000.

The Dubuque Iron Works, Dubuque, Iowa, is constructing two motor yachts, 65 feet long, 12 feet wide, for the Daily Service Corporation, Memphis, Tenn.

The Clooney Construction and Towing Company, West Lake, La., has received contracts for the construction of two small and two large barges and one dredge hull.

The Pittsburgh Steel Company, Pittsburgh, Pa., has received a contract from J. M. Hammit, to build a steel barge 350 feet by 45 feet by 11 feet.

The Tebo Yacht and Basin Company, Brooklyn, N. Y., has recently received a contract from the Donald Steamship Company, Inc., 17 Battery Place, New York, to build two steel vessels of 1,800 deadweight tons each, especially designed for use in the West Indian fruit trade. The vessels will make 13½ knots, and will be delivered in the spring of 1920.

Two 415-foot Fruit Vessels, New York.—William Gardner, naval architect, 1 Broadway, New York, has designed two 415-foot fruiters with a speed of 17 knots for fruit and passenger service for New Orleans parties.

The Japanese Government has decided on an eight-year naval programme costing $824,000,000, including the construction of four 40,000-ton battleships, four battle cruisers, twenty light cruisers, eight destroyers, seventy submarines and thirty other craft.

Hudson River Passenger Vessel.—The Hudson River Day Line, Desbrosses street, New York, has under consideration the building of a vessel on the lines of the steamer *Robert Fulton.*

Two Freight Steamers for Eastern Steamship Lines.—Theodore E. Ferris, naval architect and marine engineer, 30 Church street, New York, is preparing plans and specifications for two freight steamers to be built for the Eastern Steamship Lines. Mr. Ferris has

also prepared plans and specifications for the conversion from coal burning to oil burning of the steamers *Camden, Belfast, Calvin Austin, Northland, Governor Cobb* and *Governor Dingley,* which are operated by the Eastern Steamship Lines on their regular runs. The work of converting these steamers, which will soon be contracted for, involves large expenditures.

The Southwestern Shipbuilding Company, San Pedro, Cal., according to a statement reported to have been issued by Marco H. Hellman, president, has secured a contract involving $20,000,000 from the Emergency Fleet Corporation to build ten vessels which will be operated between the Pacific coast ports and Boston. The office address of the company is 222 H. W. Hellman Building, Los Angeles, Cal.

The Standard Oil Company of California, San Francisco, Cal., has recently placed an order for three small coastal vessels with Pacific coast yards. The vessels range from 1,200 to 4,000 deadweight tons. These contracts are in addition to the recent order for a 2,800-ton motorship, placed with the Union Construction Company, Oakland, Cal.

The Standard Oil Company of Louisiana, New Orleans, La., is about to place a contract for six oil barges with an eastern shipyard.

The Staten Island Shipbuilding Company, with office at Richmond Terrace and yards at Port Richmond, Mariner's Harbor and Arlington, Staten Island, has received a contract for six barges of the car float type from the Standard Oil Company of New York, 26 Broadway, New York. These barges will have a capacity of 250,000 gallons of No. 6½ oil in five tanks. The vessels are 150 feet long, 27-foot beam and 11 feet 6 inches molded depth.

Stephens Brothers, Stockton, Cal., are building the following vessels: one freighter, 65 feet long by 24-foot beam, equipped with a three-cylinder 60-horsepower Union engine; one light tow-boat, 30 feet long by 7-foot beam also equipped with a Union motor; four commercial runabout launches equipped with Wisconsin motors.

The Todd Shipyards Corporation, 15 Whitehall street, New York, holds a contract for one self-propelled oil barge of 1,450 tons displacement for the Sinclair Consolidated Oil Corporation, 120 Broadway, New York. This vessel is to be delivered eight months after the contract was placed (July). The machinery will be installed by the White Fuel Oil & Engineering Company, 601 Washington street, New York.

The Union Construction Company, Oakland, Cal., has recently been awarded a contract by the Standard Oil Company of California, to build a 2,800-ton oil tanker equipped with Diesel engines. The contract for the engines is held by the Skandia Pacific Engine Company, Oakland, Cal.

The Vacuum Oil Company, 61 Broadway, New York, has placed an order for one oil tanker with the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.

Vickers, Ltd., Barrow-in-Furness, has received a contract from the Australian Government for three cargo steamers of 22,500 tons each. The vessels will be 530 feet between perpendiculars, 68-foot beam and 43 feet 6 inches molded depth.

The White Fuel Oil & Engineering Company, 601 Washington street, New York, has received a contract to convert four steamers into oil burners, including the *Empress Naviera, DeCuba* of 8,000 tons, the *Habana,* and the *Julia Alondes* of 5,000 tons, as well as other contracts on large vessels about which details are not yet available.

Yarrows, Ltd., Esquimault, B. C., has received an order for a 90-foot steel ferryboat which will be operated across the river at Mission, B. C. This new vessel of the shallow draft type will draw only three feet of water. Two Wisconsin gasoline engines, providing a total horsepower of from 160 to 180 will drive the four propellers.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

New ship yards and shipyards extensions

Steamship Company, San Francisco, Cal.—The Pacific Steamship Company contemplates expanding its capital by the issue of $25,000,000 (7 percent) preferred stock. The holding company, the Pacific Alaska Navigation Company, held a meeting November 29, to issue $1,500,000 to the stockholders in the corporation.

Ship Operating Company, Portland, Ore.—The Columbia Pacific Shipping Company has increased its capital from $100,000 to $3,000,000 and intends to operate in all channels of the shipping business. Several new ships are to be built in Portland yards for this company.

Launching Ways, Humboldt Bay, Cal.—The United States Coast Guard Service is advertising for bids for building a new set of launching ways for lifeboats at the coast guard station. The work will cost between $7,000 and $8,000.

Turbine Plant For Sale, Buffalo, N. Y.—The Victory turbine plant at Buffalo, N. Y., which was built by the Navy for the Bethlehem Shipbuilding Corporation, will be sold on November 17. The property cost originally more than $1,500,000.

Wooden Shipyard For Sale, Cornwells, Pa.—It is rumored that the United States Shipping Board Emergency Fleet Corporation may offer for sale the Traylor wooden shipyard on the Delaware river at Cornwells, Pa. The yard has built eight vessels. It covers an area of about eighty acres and has several large shops of steel and concrete construction.

Shipyard Extension, Baltimore, Md.—The Union Shipbuilding Company, Baltimore, Md., whose shipyard is at Fairfield, has arranged for additional facilities that will involve an investment of $4,000,000. Two permanent concrete shipways will be added to those already built, and also a two-story office building and a one-story plant structure.

Railway Drydock, Baltimore, Md.—The Union Shipbuilding Company, Baltimore, Md., will shortly commence construction of a railway drydock capable of drydocking vessels up to 4,000 tons displacement. The dock will be constructed of timber, will measure 360 feet over the keel-blocks and will have a draft of 20 feet over the blocks. The Crandall Engineering Company, dry dock engineers, East Boston, Mass., are the designers of the dock and will superintend the construction.

Two Railway Drydocks, Burin, Newfoundland.—The Western Marine Railways, Ltd., has contracted for the building of two railway drydocks of timber construction at Burin, Newfoundland. The larger of these drydocks will measure 170 feet over the keel-blocks and will be capable of handling vessels up to 1,000 tons displacement; the smaller will be capable of handling two vessels up to a displacement of 300 tons each. The Crandall Engineering Company, dry dock engineers, East Boston, Mass., will design and construct these docks.

Dry Dock and Ship Repair Corporation, Philadelphia, Pa.—The Dry Dock and Ship Repair Corporation of Philadelphia, capitalized at $5,005,000, has been organized at Wilmington, Del., to do a general ship repair, dry dock and shipbuilding business.

Navigation Company, Boston, Mass.—The Franco-Boston Navigation Company of Boston, was recently incorporated under the laws of Massachusetts. The charter of this company authorizes it to buy, own, build and operate vessels of all types. The directors of the company are Julia W. Troy, president, Anatole Farvacque, George L. Dillaway and Nina C. Tugman, all of Boston.

Dry Dock and Repair Corporation, Brooklyn, N. Y.—The Brooklyn Dry Dock and Repair Corporation, Brooklyn, N. Y., has recently been incorporated to manufacture engines, motors and accessories.

Shipyard Reorganization, Newark, N. J.—Arrangements have been made, although the actual contracts have not been signed, for the Submarine Boat Corporation, to acquire the Newark shipbuilding yards from the United States Shipping Board. All equipment and material for the last thirty-two 5,350 deadweight ton fabricated steel freighters recently cancelled by the United States Shipping Board, will be taken over by the Submarine Boat Corporation in the deal.

Shipyard Reorganization, Alexandria Bay, N. Y.—The shipyard of Young & Butnam at Alexandria Bay, N. Y., has been purchased by Hutchinson Brothers, for repair work and new construction.

Shipbuilding Plant Completed, Mobile, Ala.—The Tennessee Coal & Iron Company has announced the completion of construction at the Chickasaw Shipbuilding plant in Mobile. The Chickasaw Company has four 9,600-ton steel hulls on the way and ten others are to be built.

Marine Railway, Solomons, Md.—A large marine railway is being built at the shipyard of M. M. Davis & Son, Inc., Solomons, Md.

Machine Shop, Wilmington, Del.—The Delaware Marine & Motor Company, Commerce street, Wilmington, Del., is planning for the erection of a new one-story machine shop.

Shipbuilding Company, Dover, Del.—The United States Diesel & Shipbuilding Corporation, Dover, Del., has recently been incorporated with a capital of $1,000,000.

Shipbuilding Company, Newcastle-on-Tyne, England.—The Newcastle Shipbuilding Company, Newcastle-on-Tyne, England, has been incorporated as a private shipbuilding company, with a capital of £100,000 ($418,000), to take over the business of the Huntley Shipbuilding and Repairing Company, Hebburn, Durham. The members of the company include H. H. Doeg, marine engine builder, G. Armstrong, shipbuilder. The first directors of the company are J. Cross and H. H. Doeg.

Shipbuilding Company, Thames, England.—A new shipyard has been organized to be known as the Medway Shipbuilding Corporation, Ltd., with a capital of £100,000, to be located on the Thames, England, opposite the Chatham dock yard. The company plans to build nine shipways, which will accommodate vessels of 10,000 tons.

Shipbuilding Companies, Peru, S. A.—The State Department, Washington, D. C., learns that three large shipbuilding plants are likely to be established in the near future in Peru, one American, one English and one Italian.

Shipbuilding Plant, Kewanee, Wis.—The Wisconsin Shipbuilding & Navigation Corporation, 216 West Water street, Milwaukee, Wis., has begun the construction of a working plant at its yard, Kewanee, Wis. The work involves about $165,000. Later the fabricating shop will double this amount, but at present this work will be done in Milwaukee.

Shipbuilding and Repair Company, New Baltimore, N. Y.—The New Baltimore Shipbuilding & Repair Company, New Baltimore, N. Y., has been incorporated with a capital stock of $45,000, to build and repair ships. W. J. Wade, W. W. Stebbins and R. B. Drew, 597 Henry street, Brooklyn, N. Y., are the incorporators.

Shipbuilding and Repair Plant, Elizabeth City, N. C.—The Elizabeth City Iron Works & Supply Company, Elizabeth City, N. C., has purchased 670 feet of river front formerly occupied by the Fuel Supply Company upon which will be located a shipbuilding and repair plant to cost not less than $100,000. This plant will be in a position to handle repairs on the largest vessels entering this port.

Ship Repair Plant, New Orleans, La.—The Jahncke Dry Dock & Ship Repair Company, New Orleans, La., has completed its ship repair plant on the Mississippi river. About $3,000,000 has been expended for land, buildings, machinery, ship ways, etc. An eleven-pontoon drydock, operated in two sections

of four and seven pontoons each can handle 4,000 and 7,000-ton vessels. When combined the drydock, which is 520 feet long, will accommodate 11,000-ton vessels. The fitting out basin is 1,600 feet long. The machine and plate shop, 320 feet by 70 feet, which is fitted with fifteen-ton cranes, and the two-story executive building furnish facilities for the adequate handling of all work.

Ship Repair Plant, Philadelphia, Pa.—The Dry Docks & Ship Repair Corporation of Philadelphia has recently been incorporated with a capital of $5,000,000.

Ship Repair Plant, Port Said.—The firm of Dowrie & Company, Port Said, has been made an Egyptian company, in which Sir John R. Ellerman, Bart., Henry Edward Barker, George Arthur Dowrie, Alfred Frederick Tunstall, Patrick Macpherson, Robert M. C. Moss, and Allan Stephenson, are the holders. The company will engage in repair and general engineering work at Port Said. All kinds of machinery and engineering material will have to be imported for this work. A. F. Tunstall and G. A. Dowrie will be actually in charge of the work.

Ship Repair Plant, Staten Island, N. Y.—Work has been begun on the 11-acre ship repair plant of Fraser, Brace & Company, 1328 Broadway, New York, located at Clifton, Staten Island. The facilities will include one 10,000-ton drydock, about 1,800 linear feet of pier space, 40 feet wide, one plate and angle shop, a blacksmith and pipe shop, and a carpenter shop, with tin and pattern shops, located in the second story.

Shipyard, Clyde, Scotland.—Hugh M. MacMillan, until recently shipyard director at Fairfield, and Donald Bremner, principal of the Port Glasgow firm of Messrs. Dunlop, Bremner & Company, are negotiating for the purchase of 650 feet of water frontage on the Clyde between the shipyard of Messrs. Yarrow and Coventry Ordnance Works. It is proposed to build five shipways on this site to accommodate vessels of from 10,000 to 12,000 tons' deadweight. Mr. Bremner will retain his position as managing director of the River Clyde Shipbuilding Works, Whiteinch. The new concern will be known as the Blythswood Shipbuilding Company.

Shipyard Combine, Quay-on-Tyne, England.—The Northumberland Shipbuilding Company, Ltd., Quay-on-Tyne, and the Fairfield Shipbuilding & Engineering Company, Ltd., Govan, are being consolidated. The former company, which operates seven berths capable of handling vessels up to 600 feet, has also obtained a controlling interest in Messrs. William Doxford & Sons, Ltd., Sunderland. The Govan company has eight shipbuilding berths.

Shipyard Control Changed, Seattle, Wash.—John H. Price, head of the J. H. Price Construction Company, Seattle, Wash., has recommenced work on two vessels standing in the yards of the Anderson Shipbuilding Company recently taken over by John L. McLean. The vessels, originally designed as steamships by Norwegian interests, will now be converted into full power auxiliary schooners.

Shipyard Discontinued, Portland, Ore. — The Albina Engine & Machine Works, Portland, Ore., according to a report, has been taken over by the Albina Engine & Machine Works Sales Company, a newly formed concern which was organized for the disposal of the stock and machinery on hand at the close of the shipbuilding programme. The consideration for the sale of the plant was given at about $220,000.

Shipyard Extensions, Perth Amboy, N. J.—The Perth Amboy Dry Dock Company, Perth Amboy, N. J., plans to build a boiler shop, a forge shop, a plate shop and a blacksmith shop on newly acquired property at the foot of Washington street, Perth Amboy. New crane runways will be constructed at both the present and the new plant to perfect the transportation facilities. Construction is now under way on a 10,000-ton sectional drydock, which will be self-docking and electrically operated. Two sections of this drydock will probably be launched before the first of next month, and the remainder as soon as possible, having in view the hauling of the first ship early in 1920, by which time the new facilities will be ready. The company now has a frontage on Staten Island of over 1,200 feet with railroad connections.

Shipyard Merger, England. — The Clyde Shipbuilding and Engineering Company, Ferguson Brothers and Murdock & Murray, three shipyards on the Clyde, will be brought under the same management by the merging of the Amalgamated Industries, Ltd., and the interests of John Slater, Ltd., London. During 1918 these yards produced 95,000 tons, exclusive of warship construction. In 1913, the yards produced 30,000 tons.

Shipyards, Ardrossan, England.—The Ardrossan Dry Dock & Shipbuilding Company, Ardrossan, England, is completing five shipways in its new south yard. Keels for vessels of 7,000 and 4,000 tons have recently been laid.

New Steamship Repair Company, Baltimore, Md.—The British American Steamship Repair Company, 51 South Gay street, Balmore, Md., has been incorporated to manufacture and repair engines and boilers. G. Alfred Peters, Jr., William M. Saunders and M. S. Chalmers, are the incorporators.

The Virginia Shipbuilding Company, Alexandria, Va., a subsidiary of the United States Steamship Company, 50 Broad street, New York, has repurchased ten vessels of 9,400 deadweight tons each from the Shipping Board at $225 per ton.

GOVERNMENT SALES

Tugs and Passenger Ship, Philadelphia, Pa.—In addition to the wooden hulls awaiting buyers at Hog Island, there are three tug boats and a passenger steamer to be sold by the Government, none of them having been built at Hog Island. The steamer is the *Cape May,* formerly the *Republic.* Some years ago the *Republic* was a famous excursion boat making daily trips between Philadelphia and Cape May.

Freighters, New York, N. Y.—The Luckenbach Steamship Company is negotiating with the Shipping Board for the purchase of four of its vessels which were requisitioned by the board. The four are 10,000-ton freighters built by the Bethlehem Shipbuilding Corporation at its Fore River plant, Quincy, Mass. The Shipping Board is asking $800,000 for each vessel in advance of the price the builders contracted for.

Boilers, Engines and Auxiliary Equipment, Piping Valves, Electric Supplies, Steel Plates, Shapes, Bars, etc.—The Emergency Fleet Corporation has available through cancellation of its war program a large quantity of surplus materials comprising boilers, engines and auxiliary equipment, piping valves, electrical supplies, steel plates, shapes, bars, etc., plumbing material, yard and shop handling devices, shop and wood-working machinery and tools, railroad equipment and a large lot of miscellaneous supplies. The prices for this material are considerably below the present market in most cases. Address inquiries to the home office of the Supply and Sales Division, 140 North Broad street, Philadelphia, or to the District Office, located at 139 Centre street, New York.

Steel Plates, Shapes and Bars, Philadelphia, Pa.—The Emergency Fleet Corporation, 140 North Broad street, Philadelphia, Pa., announces that it will offer for sale through its district offices about 200,000 tons of surplus steel in the form of plates, shapes and bars. Much of this material is fabricated and probably cannot be disposed of except as scrap. Sales will be made by means of competitive bids.

Yachts, Destroyers, Scows, Lighters, Barges and Motor Boats, Washington, D. C.—The Navy Department is advertising for sale a large number of vessels, including yachts, destroyers, scows, lighters, barges and motor boats. During the war the Navy built more than 455 submarine chasers, each 110 feet long, fitted with three standard gasolene engines of 220 horsepower each. These boats have been appraised at very low values in comparison with their original cost of from $75,000 to $80,000 each. According to Secretary Daniels, the terms of the sale are lenient. On vessels taken over during the war, a 10 percent deposit is required with the bid.

Wooden Ships, Washington, D. C.—The Emergency Fleet Corporation has placed on sale nearly 200 wooden ships of 3,500 tons deadweight, mostly of the Ferris type, at a fixed price of $75,000 each. The ships are to be sold at the Shattuck yard, Portsmoutn, N. H.; Wilson's Point, South Norwalk, Conn.; Maryland Shipbuilding Company, Baltimore, Md.; Hog Island, Philadelphia, Pa.; Beaumont, Texas; Alameda, Cal.; Columbia Slough, Portland, Ore.; Lake Union, Seattle, Wasn.

Battery Trucks, Tractors, a Battery Charging Plant and a Battery Crane Truck, Portland, Ore.—The Commission of Public Docks, Portland, Ore., has recently awarded a contract for furnishing two battery trucks, two battery tractors and a one-ton battery crane truck to the Automatic Transportation Company. The Commission has also recently awarded a contract for an electric battery charging plant to the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

HARBOR IMPROVEMENTS

Channel Improvement, James River, Va.—The Atlantic Deeper Waterways Association recently passed a resolution asking the Federal Government to make a new survey of the Lower James River with the view of deepening the channel from City Point to Newport News. The proposal includes dredging the channel to a depth of 25 feet.

Channel Improvements, Astoria, Ore.—As a result of the recommendations to be made by Secretary Daniels for the establishment of a naval base in the Columbia at a cost of $7,000,000, the improvement of the Columbia and Willamette river channels is urged, so that large war vessels may be accommodated. The Tongue Point site at Astoria is suggested, as it is strategically suited for a base.

Ship Canals, New Jersey.—The proposal to build a ship canal across New Jersey, to connect the existing inland waterway system, extending south to Florida, with the coast, has been submitted to the Rivers and Harbors Committee of the House by the New York and New Jersey Port and Harbor Development Commission. The state of New Jersey has appropriated $1,000,000 to acquire the right of way for this canal, which will run from Bordentown on the Delaware to Morgan on Raritan Bay.

Jamaica Bay Terminals, Long Island, N. Y.—The Sinking Fund Commission of New York City adopted a resolution recommending that the Board of Estimate authorize the issue of $7,500,000 corporate stock for the construction of six 1,000-foot piers. These piers will be built on condition that Congress authorize the construction and maintenance of a 30-foot entrance channel 1,500 feet wide, extending through Rockaway Inlet to Jamaica Bay, and a 30-foot interior channel, 1,000 feet wide, extending from the entrance channel to Mill Basin, and that the necessary dredging appropriations for this work be contributed by the Government.

Harbor Developments, Great Lakes District.—The United States Government is preparing to expend $5,000,000 on the following channel and harbor improvements for the benefit of the Great Lakes commerce: The deepening and widening of Livingstone Channel will be commenced soon. The proposed width is 450 feet. It has been estimated that $3,500,000 will be necessary to complete this work; the deepening and the widening of the Grosse Point Channel, to cost about $250,000 and the River Rouge improvement will involve the expenditure of $500,000. The east dyke at

St. Claire Flats is to be repaired at an expense of approximately $40,000 for the protection of Lake shipping; the Harbor of Refuge at Harbor Beach, will be dredged at an approximate cost of $150,000 to afford shelter to vessels from storms, and a breakwater is to be constructed at Alpens, at an estimated cost of $75,000.

Wharves, Cape Fear River, Fayetteville, N. C.—The city of Fayetteville, N. C., has voted the issuing of $75,000 in bonds for the construction of wharves on the Cape Fear river. For further information address the Mayor.

Terminal Developments, Seattle, Wash.—The Seattle Harbor Commission on recommendation of George F. Nicholson, engineer, has authorized asking for bids for the construction of the first half of the East transit shed at the New Smith Cover pier "B" terminal, which is to include the passenger accommodations to be erected. Bids for this work will be opened November 26 and plans and specifications may be had on application to the engineer in Seattle. The Commission has also decided to ask for bids for the erection of four additional oil storage tanks at Smith Cover, pier "A," each to be of steel or concrete and of 50,000 gallons capacity. The date for the opening of these bids has not been set.

Harbor Developments, Kalamata, Greece.—A project is on foot for the development of the port of Kalamata, Greece, which offers a possible opportunity for an American firm. The improvements contemplated include the deepening of the harbor, the construction of waterworks, the dredging of the river, and a number of minor improvements. It is estimated that the cost of deepening the harbor would amount to approximately 1,000,000 drachmas ($193,000).

Coaling Machines, Norfolk, Va.—The Division of Operations of the United States Shipping Board, Emergency Fleet Corporation, invites bids for the sale of coaling machines and spare parts, among them being five new DeMayo 40-foot machines manufactured by the American Car & Foundry Company, Berwick, Pa. These machines and spare parts are now in storage at the Engineer's Depot, Lambert's Point, Norfolk, Va. Permission to inspect may be had upon application to Mr. L. L. Leger, Purchasing Agent, Division of Operations, Flat Iron Building, Norfolk, Va.

Wharves and Warehouses, Beaumont, Tex.—The city of Beaumont, Tex., because of traffic having diverted to southern ports by the Shipping Board, intends to spend $500,000 immediately in building adequate wharves and warehouse to handle the cotton, lumber and oil which are shipped from the port.

Ship Channel, Miami, Fla.—The city of Miami, Fla., has voted on $40,000 bonds for the completion of a ship channel across Biscayne Bay. J. T. Blackmon is the acting mayor.

Inner Harbor Navigation Canal, New Orleans, La.—The Dock Board, New Orleans, La., is planning to issue $7,500,000 in bonds for the completion of the inner harbor navigation canal. J. B. O'Reilly is the engineer.

Reinforced Concrete Pier with Bridge and Ferry Slip, Bay Shore and Rock Hall, Md.—The Baltimore & Eastern Shore Ferry Line, S. A. Tubman, vice-president and manager, Room 613, Lexington building, Baltimore, Md., plans to construct a 1,000-foot reinforced concrete pier with bridge and ferry slip at Bay Shore, and at Rock Hall, Md. M. D. Swartz, Madison avenue and Preston street, Baltimore is the engineer, and the Raymond Concrete Pile Company, Baltimore, is the contractor.

Dredging and Rock Removal, East River, N. Y.—The New Jersey Shipbuilding and Dredging Company, Bayonne, N. J., has been awarded a contract for dredging and rock removal in the East River, New York, at a cost of $668,122.

Harbor Development, Wilmington, Del.—The City Council of Wilmington, Del., has authorized a bond issue of $2,500,000 for the purpose of developing the port. The work will include the building of a bulkhead wharf 1,200 feet long, a three-story warehouse 600 feet by 200 feet, and the dredging of the ship channel to a depth of 35 feet, so that ocean-going vessels will be able to dock. Cranes and cargo-handling machinery of the latest types will be installed. An additional appropriation of $150,000 has been made for the construction of sheds and bulkheads and river craft at the railroad terminals.

Port Improvements, Cincinnati, O.—About $175,000 is to be spent in improving the wharves and docks of Cincinnati.

Harbor Improvements, Portland, Ore.—The Port of Portland Harbor Commissioners, Portland, Ore., plan to purchase Swan Island. It is expected that this location will be dredged out and serve as a boat basin, or the island itself may be equipped with docking facilities.

Navigation Canal, New Orleans, La.—The Dock Board, New Orleans, La., is planning to issue $7,500,000 in bonds for the completion of the inner harbor navigation canal. J. B. O'Reilly is the city engineer.

Pier, Baltimore, Md.—B. Powell Harrison, harbor engineer, Baltimore, Md., recommends the building of a large, modern pier at McComas street, at an estimated cost of $400,000. The Board of Estimates is considering the temporary diversion of civic center funds to this use.

Pier, Charleston, S. C.—The Standard Oil Company plans to construct a 1,200-foot dock at Charleston, S. C., to accommodate two vessels. G. R. Lukesh is in charge of the work.

Pier, West Waterways, Seattle, Wash.—The Frank Waterhouse Company, Seattle, Wash., has applied to the Seattle Port Commission for a permit to build a pier at the northwest section of the West Waterways. According to the plans submitted to the commission, the Waterhouse Company seeks to extend its property 155 feet on to the Railroad avenue waterway extension. If permission is granted for this construction, it is understood that the expenditure for the pier will be about $2,000,000.

Sales Building, London, England.—Irving T. Bush has made arrangements for leasing the Strand Aldwych site in London to the Bush Terminal Company for ninety-nine years, at an annual rental of £55,000. The building to be erected on this site will be eight stories high.

Steamship Office Building, New York.—A. H. Bull & Company, 17 Battery Place, New York, has purchased a five-story building, 34-40 West street, New York, which will be used for future developments of the company's executive offices.

Ship Channel, Biscayne Bay, Fla.—The city of Miami, Fla., has voted on $40,000 bonds for the completion of a ship channel across Biscayne Bay. J. T. Blackmon is the acting mayor.

Steamship Terminals, Hunt's Point, New York.—Robert Dollar, president of the Dollar Steamship Company, San Francisco, Calif., has purchased fourteen acres of property providing 700-feet of waterfront at Hunt's Point, Bronx, New York, which will be developed for steamship terminals to be used when the company extends its service to New York. The sum of $356,250 was paid for the tract. H. P. Schuck, general manager of the Dollar Steamship Company in New York, has stated that $1,000,000 would be spent in the construction of harbor facilities at this point.

Terminal Project, Jamaica Bay, L. I.—A $100,000,000 syndicate, in which Alton H. Greeley, one of the principal warehouse owners in Cleveland, is interested, plans to construct piers and warehouses at Jamaica Bay, L. I. The beginning of construction work on the project rests upon Federal action in providing a 30-foot channel.

Terminal Reconstruction, Memphis, Tenn.—The City of Memphis, Tenn., plans to spend $178,000 in remodeling its existing terminals. Freight will be handled from barge to warehouse or cars by means of tractor or trailer trucks. These trailer trucks will be elevated to the bank by means of a tractor conveyor incline. On the upper level trailers will be moved by electric tractors. As the work has just been authorized, working plans are not now available. The construction does not include warehouses or piers. W. F. Schulz is consulting engineer.

Terminals, Cordova, Ala.—Manager Henry T. DeBardeleben, of the Warrior River Barge Canal Commission, has announced that contracts will soon be let for the construction of terminals at Cordova, Ala., to cost about $30,000.

Turning Basin, Birmingham, Ala.—Charles F. Wood, engineer, Birmingham, Ala., recommends the building of a turning basin in connection with the river barge terminals at this port.

Wharf, Pascagoula, Miss.—Bids were received on November 10, by C. H. Lewis, mayor, Pascagoula, Miss., for the construction of a 1,000-foot wharf including the laying of 3,000 feet of rails. About $75,000 will be spent on the work. W. H. Wallis is the engineer.

Wharves, Cape Fear River, N. C.—The city of Fayetteville, N. C., has voted to issue $75,000 in bonds for the construction of wharves on the Cape Fear river. For further information address the Mayor.

SHIPPING DEVELOPMENTS

New Steamship Company, New York.—The Green Star Steamship Corporation, headed by Joseph Mercadante, formerly president of the Nafra Company, and Robert McGregor, formerly general manager of the Federal Shipbuilding Corporation, has been incorporated with a capital of $10,000,000 to develop world trade. Ten steel Shipping Board vessels will be placed in this service.

New Steamship Companies, New York.—F. & J. Auditore, stevedores, 44 Sackett street, Brooklyn, and Charles L. Apfel, attorney-at-law, 35 Nassau street, New York, have organized the Susquehanna, Redondo, Sacramento and Lydia Steamship Companies to operate vessels in world trade.

Shipping Combine, Seattle, Wash. — The Universal Shipping & Trading Company, Seattle, Wash., will become amalgamated with the shipping firm of Frank Waterhouse & Company, according to a statement made by F. H. Hammer, president and general manager of the former company. The new organization will enter the Eastern shipping field at once.

The Green Star Steamship Corporation, 120 Broadway, New York, has purchased four 8,800-ton deadweight cargo carriers which are being built by the Northwest Steel Company, Portland, Ore.

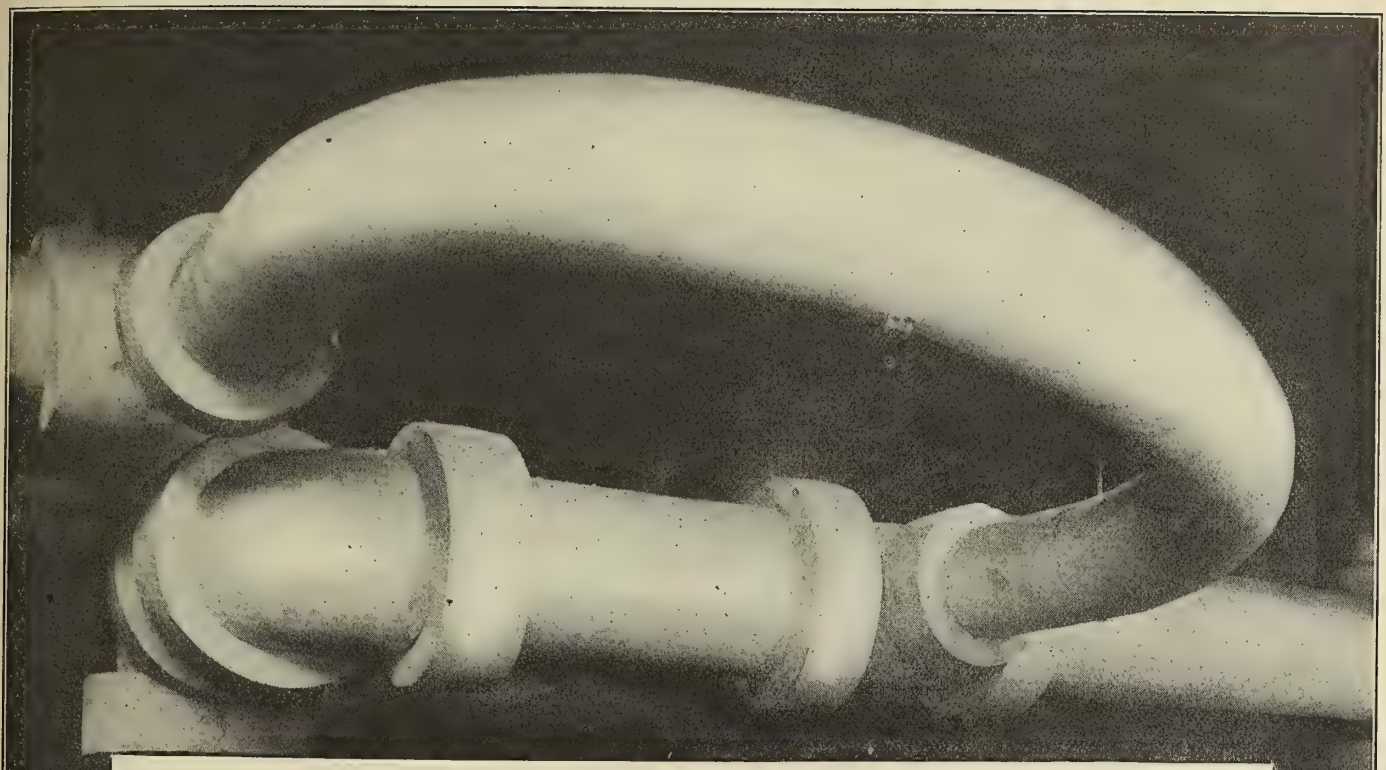
Large Oil Depot, Belfast, Ireland.—Preparations have been made for the establishment of a large oil depot at Belfast, Ireland. Wharfage will be provided for oil tankers ranging from 10,000 to 20,000 tons.

New British Ship Venture in Central Europe.—A report from reliable sources states that British capital has purchased a controlling interest in the Danube Steamship Company, which operates and practically controls inland water navigation in Central Europe. The company is capitalized at 54,400,000 crowns, including a valuable coal mine at Funfkirchen, Hungary.

New Shipping Combine, Antwerp, Belgium.—The American Chamber of Commerce in London states that a new Franco-Belgian shipping combine has been formed in Antwerp with a capital of 25,000,000 francs. The steamers will sail under the Belgian flag to Canada, the United States and points on the Pacific coast from Antwerp.

New Shipping Company, Wilmington, Del.—The United Shipping Company, Inc., care of Delaware Registration Trust Company, 900 Market street, Wilmington, Del., has recently been incorporated.

New Shipping Company, Jacksonville, Fla.—The Jacksonville Shipping Corporation, Jacksonville, Fla., has recently been incorporated.



"85% Magnesia" for *Permanence*—

Although the Calco Chemical Co's plant at Bound Brook, N. J., was built to meet a wartime emergency, it was also planned as a *permanent* unit of America's marvelous new Chemical Industry.

So its designers and engineers chose the most *permanent* as well as the most *efficient* heat insulation—"85% Magnesia" — the world's standard heat and coal saver.

The Coal Bills in a plant such as this are a big item in the cost of manufacture, and their engineers knew that "85% Magnesia" would keep them down to the minimum.

So every piece of equipment—steam pipes, boilers, valves, flanges and fittings—is covered with this master heat insulation; so effectively, that it may be safely said, heat waste is virtually eliminated.

No other material so nearly approaches perfection in its marvelous microscopic air cell structure, in its adaptability to every form of heat container, or in its *permanent* efficiency under all conditions of pressure or temperature, as does "85% Magnesia."

Thousands of industrial plants reduce their fuel bills with this master heat insulation.

Does Yours?

If not, write for the new Table of Actual Monthly Coal Saving in Dollars and Cents, prepared by the Mellon Institute of Industrial Research. To Engineers and Architects we will also send the Specification for the correct application of "85% Magnesia" coverings, compiled by the same institute.

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BUSINESS NOTES

Under the name of the S K F Industries, Inc., the Hess-Bright Manufacturing Company, the Atlas Ball Company, the Hubbard Machine Company and the S K F Ball Bearing Company will operate after May 1. B. G. Prytz is president of the consolidated company; W. L. Batt, vice-president; J. P. Walsh, comptroller, and S. B. Taylor, sales manager. The principal office of the company will be located at 165 Broadway, New York city.

Raymond F. Brown has been appointed purchasing agent of the Bantam Ball Bearing Company, Bantam, Conn., to succeed C. D. Stoddard, resigned.

The Terry Steam Turbine Company, Terry Square, Hartford, Conn., announces the appointment of R. L. Thomsen as sales manager. Mr. Thomsen was formerly manager of the marine department for the Griscom-Russell Company.

Dean Bros. Steam Pump Works, Indianapolis, Ind., manufacturer of steam pumps, announces the establishment of a New York office at 141 Broadway, in charge of H. Meachem.

The Black & Decker Manufacturing Company, Baltimore, Md., has established a New York office in the Equitable building, Room 2920, in charge of G. R. Lundane, formerly connected with the Thomas B. Jeffery Company and the Findeisen & Kropf Manufacturing Company.

The Steward Davit & Equipment Corporation, 17 Battery Place, New York, announces the appointment of Capt. A. T. Hunter as Pacific Coast agent, with offices in the Sherwood building, San Francisco, Cal.

The Fulflo Pump Company, Blanchester, Ohio, has opened an office at 6253 Ellis avenue, Chicago, Ill., in charge of R. E. Manly, of the Manly Sales Company.

The Joseph Dixon Crucible Company, Jersey City, N. J., announced the removal of its Philadelphia sales office from 1020 Arch street to Rooms 801 and 802 Finance building, South Penn Square, Philadelphia, Pa., on May 1.

Gray & Hunter, Inc., 17 Battery Place, New York, will be the American representative for Dudgeon & Gray, Ltd., 89 Aldgate, London, marine surveyors, consulting engineers and naval architects.

The Emergency Fleet Corporation has opened offices at 615 City Bank building, Mobile, Ala., under the management of G. J. Santa Cruz.

The Chicago Pneumatic Tool Company, Chicago, Ill., announces that it has taken new offices in the Majestic building, Room 1418, Milwaukee, Wis.

The Van Dorn & Dutton Company, Cleveland, Ohio, has opened offices at 1241 First National Bank building, Chicago, Ill., under the management of Harry F. Keegan, and in New York at Room 317, 30 Church street, under the management of John Keegan.

Frederick Morris, 2022 Spruce street, Philadelphia, Pa., has been appointed authorized representative of the United States Shipping Board Emergency Fleet Corporation at the Hog Island shipyard to succeed H. E. Frick.

R. B. Cory Company, Inc., 39-41 Cortlandt street, New York city, announces the election of Charles L. Eidlitz as president.

The McMyler-Interstate Company, manufacturers of car dumpers, locomotive cranes, ore and coal-handling machinery and railroad equipment, Bedford, Ohio, has opened an office in the Hoge building, Seattle, Wash., under the management of W. R. Hendry. This office will cover the States of Washington, Oregon and the northern part of Idaho.

Under the direction of J. C. Sague, the Duntley-Dayton Company has opened a branch office at 411-412 Century building, Cleveland, Ohio. W. M. Hankey has opened a branch office at 826 Home Trust building, Pittsburgh, Pa.

The Henry Engineering Company has opened an office at 71 Bay street, Toronto, Canada. The company, which is composed of Thomas Henry, James A. Rumjay and Edwin B. McBride, will act as consulting engineers on general engineering work.

The Boston offices of the Chicago Pneumatic Tool Company have been re-

The Universal Gas with the Universal Service

Every concern having a production problem involving the joining or sundering of metals, or the maintenance of machinery, will naturally be led to oxy-acetylene because of its greater range of serviceability, its economy and flexibility.

"PREST-O-LITE",—as the convenient portable cylinder with its contents of purest (ready-made) acetylene is called—is the gas without limitations, dissolved chemically so that a large quantity is available in small bulk.

Once your initial supply of cylinders is at hand, you are ready for any kind of flame heating operation—from the lightest soldering or brazing to the heaviest welding and cutting jobs—for the least time and money cost. It is then the business of PREST-O-LITE service to insure your prompt replacements.

The Gas of a Thousand Uses

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DISSOLVED ACETYLENE

Whether the job be on the superstructure of a steel bridge or in a mine or the hold of a vessel, PREST-O-LITE is always ready to be carried to the spot and to deliver its contents efficiently and conveniently.

Thanks to PREST-O-LITE'S part in the war, there are today more plants and more cylinders than ever before—a great asset to every user, present or prospective. We'd like to tell you more about PREST-O-LITE Service and the plan under which our users enjoy it.

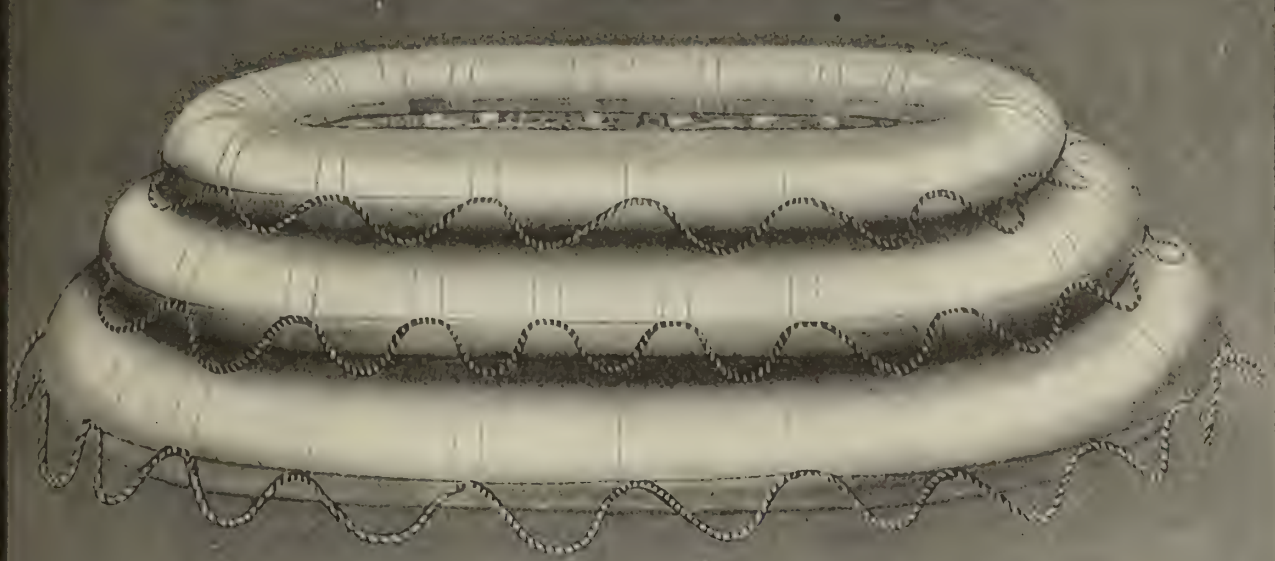
THE PREST-O-LITE CO., Inc., General Offices, 42nd St. Bldg., New York City

Kohl Building, San Francisco

128A

SAFETY AT SEA

We do our bit in the manufacture of Marine Life-saving Appliances that will safeguard the lives of our officers, sailors, gunners and troops on ships going into the war zone



A nest of A. B. C. Life Rafts—Balsa Wood

For a great many years we have specialized in the manufacture of the highest grade of marine lifesaving equipment such as:

Lundin Decked Lifeboats
Lundin Motor Lifeboats
Welin Quadrant Davits
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Standard Metallic Lifeboats with "Steel Keels"
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Metallic Cylinder Life Rafts
Mills' Releasing Gear
A. B. C. Life Rafts
A. B. C. Life Preservers
A. B. C. Ring Buoys
Welin Gripe Release
Welin Non-Toppling Blocks

Our policy is: "The best is none too good"

Catalog on Request

AMERICAN BALSA COMPANY, Inc.

Welin Marine Dept. **50 E. 42nd Street, New York**

London House: 5 Lloyds Avenue, London, E. C.

moved to 182 High street, Boston, Mass. F. S. Eggleston is district sales manager. J. I. Edwards has been appointed manager of the rock drill sales division of the company, succeeding E. Eklund, who, as foreign representative, will shortly leave for Europe in the interests of the company. Fred H. Waldron, formerly Minneapolis representative of the Chicago Pneumatic Tool Company, has been appointed manager of the pneumatic tool sales division, with offices in the Fisher building, Cchicago. Nelson B. Gatch succeeds him at Minneapolis, with offices at 301 Metropolitan Bank building. The company also announces the appointment of J. K. Haigh as assistant district sales manager at the San Francisco office, 175 First street, San Francisco, Cal.

The American Concrete Pipe Association, 210 South La Salle street, Chicago, Ill., was reorganized at the recent convention held in Chicago. The association now comprises approximately 400 manufacturers of concrete drain tile and sewer pipe in the United States and Canada. It is planned to include the members of the Pacific Concrete Pipe Association and the Northwest Concrete Pipe Association in the larger unit

Steuart S. Rydehn has been appointed factory superintendent of the Bantam Ball Bearing Company, Bantam, Conn., to succeed Edward H. Cox, resigned.

Frank R. Farnham, formerly sales and advertising counsel of Hollister White & Company, has become vice-president of Rex W. Wadman, Inc., technical advertisers.

The Aberthaw Construction Company, Boston, Mass., announces the establishment of a Philadelphia office at Room 101, West End Trust building, under the management of E. V. Schafer, formerly assistant mechanical engineer of the League Island air craft factory.

A. E. Dorie has resigned as president of the Savage Arms Corporation to become chairman of the board of directors. W. L. Wright succeeds him as president. F. R. Phillips has been elected vice-president, F. R. Pleasanton continues as general works manager, and Arthur F. Hebard becomes general sales manager. F. R. Schafer remains sales manager of the Sharon plant. Brockholst Mathewson will represent the company in Detroit.

Creighton Churchill and Charles L. MacLeod have formed the firm of Churchill & MacLeod, with offices at 512 Fifth avenue, New York city. These men, with assistants, have made analytical studies of operations in over 50 percent of the shipyards in the country under the auspices of the Emergency Fleet Corporation, and are planning to utilize this accumulated knowledge for the benefit of the entire shipbuilding industry in its competition with foreign yards.

The Lunkenheimer Company established new offices at 129 to 135 Lafayette street, New York city, on May 1.

The Hauck Burner Service Station, in charge of H. Harrison Kress, 1711 Sansom street, Philadelphia, Pa., has occupied the entire three-story building at 1718 Sansom street since May 1.

Allan E. Goodhue has been appointed managing director of the English subsidiary of the Chicago Pneumatic Tool Company, known as the Consolidated Pneumatic Tool Company, Ltd., 170 Piccadilly, London, and Fraserburg, Scotland. Mr. Goodhue was previously connected with the Midvale Steel & Ordnance Company before entering the Government service as assistant manager of the steel and raw materials section, production division of the Emergency Fleet Corporation.

The Bailey Meter Company, East Forty-Sixth street and Euclid, Cleveland, Ohio, will move its main office and works from Boston, Mass., to Cleveland, Ohio, on May 1. H. D. Fisher will maintain the Boston office to handle sales and engineering service work in the New England district, also handling inquiries from New York and Philadelphia.

The H. T. Shearer Machine Company, Waynesboro, Pa., has recently opened up its second plant at Waynesboro, in which it will manufacture bridge and boiler reamers exclusively. The company has specially designed machinery for the manufacture of these reamers, and expects to raise the capacity to 600 reamers per day within the next sixty days.

FOR SALE

SURPLUS MATERIAL AND EQUIPMENT

All classes of ship construction and Shipyard Plant Construction equipment and material including large quantities of

Wood Working Machinery
Machine Tools and Fixtures
Electrical Machinery
Boiler Shop Equipment
Forge Shop Equipment
Marine Equipment and Accessories
Air Compressor Equipment
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Bridge and Gantry Cranes
Steel Plates, Shapes and Bars
Pumping Machinery
Scrap Metals
Lumber
Deck Equipment
Galley Equipment

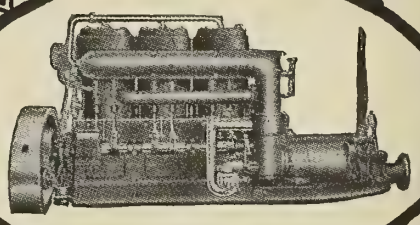
All parties interested in the purchase of any of the foregoing classes of material will receive formal invitations to bid periodically as the material is available if they will promptly request that their names be placed on mailing lists for the items in which they are interested.

SALVAGE—UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION
140 North Broad Street, Philadelphia, Penna.

Real WOLVERINE Power
"The Motor With the Bore & Stroke"

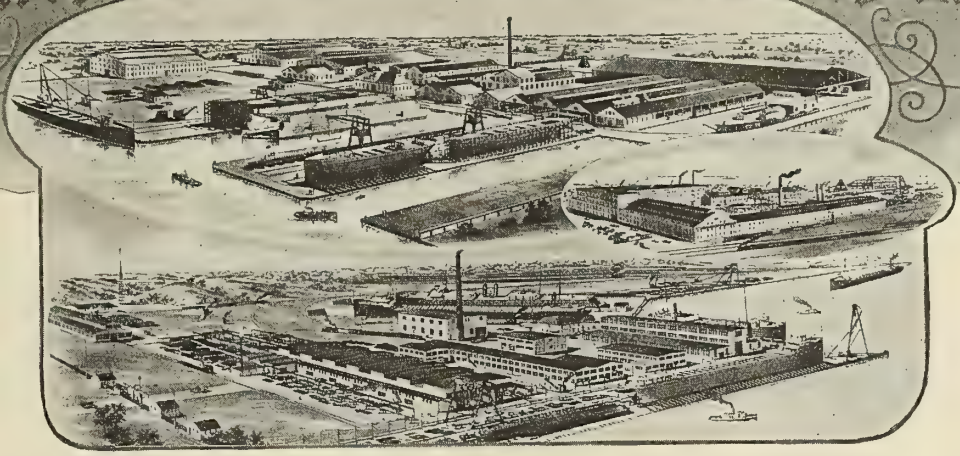
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from 70 to 80% without sacrificing reliability, flexibility or control. Perfect combustion on Kerosene or lowest grade of Coast Distillate.
Sizes from 5 to 200 H. P.
1 to 6 Cylinders

Kerosene
The gasoline question has been solved by the
WOLVERINE MOTOR WORKS
Bridgeport, Conn., U. S. A.



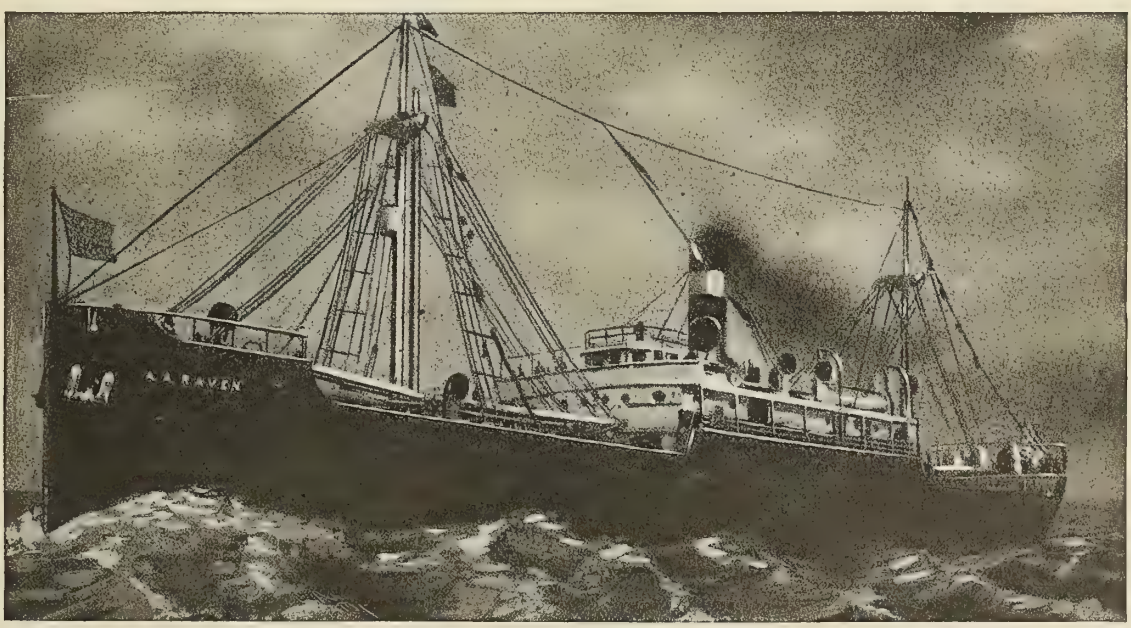
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Great Lakes Engineering Works



Steel Ship and Engine Builders

Detroit, Michigan, U. S. A.



Over sixty steel ships have been built by us for over sea trade and forty-eight are now under construction.

Emergency Fleet Corporation Establishes Plant Disposal Section

Before retiring as director-general of the Emergency Fleet Corporation, Chas. Piez created a new department, known as the Plant Disposal Section, which will be in charge of B. E. Grant, engineer of the shipyards plant division.

This new division will handle the difficult economic problem of disposing of the Emergency Fleet Corporation interests in wood, concrete and steel shipyards, and also in fabricating plants totaling several hundred millions of dollars. The plan is to put these shipbuilding units which are capable of such disposal into private hands as going concerns, so that the enterprises may be continued on an economic basis. Every means will be taken to prevent all possible wastage of money and materials.

The most difficult problem will be the disposal of the very large yards—Hog Island, the Merchant Shipbuilding Corporation, Bristol, Pa., and the large plant of the Submarine Boat Corporation, Newark, N. J. In these cases it will probably be necessary to adapt the facilities of the plant to other types of work, as during peace times shipyards of such gigantic proportions could probably not be operated profitably.

Shipping Developments

Alaska Territorial House of Representatives has passed a bill appropriating $300,000 to provide funds for the entering of the Territory of Alaska into transportation business through the chartering of ships from the United States Shipping Board, and to petition Congress for a $5,000,000 bond issue to further the project. The bill makes the Governor, in this case Governor Riggs, secretary and treasurer of the proposed Alaska Shipping Board.

Willamette Plant Establishes Record

Outfitting 24 steel steamers of the 8,800-ton design in twenty-one months will be the record of the Willamette Shipbuilding Company, Portland, Ore., when the *West Nohno* has been delivered. During the week of April 19, six Scotch marine boilers were shipped to Puget Sound yards, three to the Ames shipyards, and the same number to the Todd Dry Dock & Construction Corporation. Six others were shipped to J. F. Duthie & Company, Seattle, Wash., on April 20.

Canada to Enter West Indian Export Field

Business men in England are looking for Canada to become an important factor in British West Indies trade, which is now held largely by United States exporters. The favorable export balance of the United States, it is stated, has been gained principally because of lack of shipping from Great Britain and on account of the necessary concentration on war production.

Portland Drydock Will Cost $1,000,000

According to the latest estimate by G. B. Hegardt, engineer and secretary of the Commission of Public Docks, Portland, Ore., the new drydock which the city proposes to construct will cost slightly less than $1,000,000, including ship repair facilities, but not including the site; the drydock will be of the floating type.

The port authorities at Portland, Ore., are considering the building of storage tanks to accommodate 16,000 barrels of vegetable oil. Engineer Hegardt has recommended that bids be called for on two tanks of 1,000 barrels each, two tanks of 2,000 barrels each, and two tanks of 5,000 barrels each. At a rough estimate it has been computed that the boilers, piping and full equipment for this construction would cost about $48,000. The engineer has also submitted a report concerning the construction of a single-story warehouse to cost between $92,000 and $99,000, depending upon the construction used.

Max A. Houser, president of the Port of Portland Commission, has requested that the Portland Chamber of Commerce give its support for the appropriation of $10,000,000. This fund will not be used in actual harbor construction, but to establish traffic bureaus and other organization committees which will make the investment in actual harbor facilities profitable.

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INTERNATIONAL
COMPOSITIONS FOR IRON AND STEEL VESSELS' BOTTOMS
In use and in stock at all ports of the world. Over 18,000,000 gross tons of shipping coated annually
Proprietors of INTERNATIONAL COMPOSITION, ANTICORROSIVE, and ANTIFOULING
INTERNATIONAL COMPOSITIONS CO. Offices, Welles Bldg., 18 Broadway, N. Y.

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GENERAL WELDING & EQUIPMENT CO.
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107 MASS. AVE. BOSTON, MASS.

WELDING & CUTTING EQUIPMENTS.

HIGH QUALITY AND EFFICIENCY, LOW COST OF OPERATION AND MAINTENANCE, OPEN MODERN CONSTRUCTION, ACCESSIBILITY AND EXCHANGEABILITY OF EVERY ESSENTIAL PART AND THE CONSIDERATE SERVICE WE FOLLOW UP WITH—HAVE BUILT UP A REMARKABLE TRADE WITH THE MOST PROMINENT CONCERNS.

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Varying Tonnage on the Warrior Barge Canal

W. D. Nesbitt, chairman of the Alabama Board of Economy and Control, has pointed out that in addition to the coal-handling possibilities, the Warrior River should make Mobile the seaport for Birmingham, Selma, Montgomery and other large inland cities through the handling of cotton, steel and other inland products by this route. The barge equipment is satisfactory for this greater development. The building, however, of the added terminal facilities and cargo-handling machinery would be necessary to make the scheme financially profitable.

American Steel Market in England

The recent cut of $4.25 in American prices for pig iron and of $12.00 on finished steel is causing considerable anxiety to steel manufacturers in England. British manufacturers see their overseas trade threatened, and even their domestic markets prejudiced, by discrepancy in prices in favor of the United States. A further cut, it is reported, might make it possible to bring American steel, freight and all, into the British market at less than the British price. The city of Birmingham, England, for instance, has placed a large order for street car rails with an American concern. Price and guarantee of delivery secured the contract for the American bidder.

TRADE PUBLICATIONS

Lovekin Pipe Joints are described by the Lovekin Pipe Expanding & Flanging Machine Company, Philadelphia, Pa., in a catalogue just issued. "These joints withstand all pressures of steam, air, gas and hydraulic—far beyond the point where the pipe itself will burst. They are in reality mechanically produced hand-peened joints with important improvements. The most economical in maintenance, and the only practical joints insuring absolute tightness. As all navy yards and most shipbuilding plants use them, won't you consider our method now?"

Pneumatic Tool Hose is described in an illustrated circular issued by the the New York Belting & Packing Company, 91 Chambers street, New York. "Whatever performance you demand of tool hose, 'Indestructible' will supply with full measure of satisfaction. Strength is its inherent quality—will positively not kink—the thick, tough rubber cover stands the constant dragging over rough places. The heavy, seamless rubber tube is proof against injury from oil which is bound to get into your air lines. The braided jacket is a giant in strength."

The Midwest-Diesel Oil Engine is described in a bulletin issued by the Midwest Engine Company, Indianapolis, Ind. "Here is the Midwest-Diesel directly reversible marine oil engine—a brute for strength and a wizard for economy and efficiency. Among its distinctive features is the open crank case, that affords the utmost convenience for inspection and adjustment. Pistons, with their rings, are removable without dismounting the cylinder heads or connecting rods. Simple, positive control for maneuvering ahead and astern guarantees extreme flexibility of operation."

Shepard Hoists are described and illustrated in circulars published by the Shepard Electric Crane & Hoist Company, 328 Schuyler avenue, Montour Falls, N. Y. "Where you find Shepard hoists there you find work is carried on with the highest degree of efficiency, for each 'Shepard' represents a saving in time and labor—one man can operate a 'Shepard' and handle a piece it would take a gang to lift, and in half the time. Give a 'Shepard' consistent, steady, 'day-in-day-out' work—it's sturdy and built for that kind of service. It's unaffected by dirt, dust or dampness—because all electrical and mechanical parts are protected by the 'closed-in' unit construction. The Shepard line includes traveling cranes, monorail cranes and hoists with either plain or motor-operated trolleys, ½ to 30 tons. Our engineers will be glad to serve you."



WE HAVE MADE

PROPELLERS

FOR THE FOLLOWING CONCERNS:

American and Cuban S. S. Co.
Baltimore Dry Dock & Shipbuilding Company
Bethlehem Shipbuilding Corporation
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Federal Shipbuilding Company
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Newport News Shipbuilding & Dry Dock Co.
New York Shipbuilding Corporation
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Pocahontas Fuel Company
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Which Proves

that we can fill your requirements

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DRAW UP THE BOLTS OF A JOINT–

and you'll want a packing there that will meet a host of needs—each one essential.

Seventy odd years of experience and experiment is the basis on which we have produced

FIRO SUPERHEAT SHEET PACKING

Where temperatures and pressures are high, it has no equal.

FIRO will not char or harden in a joint, never flattens out between the flanges when you draw up the bolts and it is positively non-absorbent. Its permanency insures both plant economy and safety of your men.

Carried in stock in 1-32″, 1-16″, 1-8″ thicknesses. Sheets measure 40″ x 40″.

NEW YORK BELTING & PACKING CO.

MECHANICAL RUBBER GOODS

NEW YORK

CHICAGO ST. LOUIS SAN FRANCISCO PITTSBURGH PHILADELPHIA BOSTON

WRITE FOR SAMPLE

"The Test of Adaptability" is the title of a circular published by the Graton & Knight Manufacturing Company, Worcester, Mass. "For some materials there is no substitute. Such, for instance, is leather for belting. Its superiority for all the major requirements is recognized by transmission experts. The belt shown above, for instance, was transferred from one drive to another—lengthened by splicing and cut cut down 2 inches in width—an adaptation that is possible only with leather. The advantages of leather for transmission are developed to their maximum in Graton & Knight standardized series leather belts. They are that rare thing in business—a highest-quality line enjoying the largest sales. Do you know of any other brand in any highly competitive field that combines highest grade with biggest sale? Talk that over in your transmission conferences."

Wetmore Expanding Reamers are the subject of Bulletin No. 11, recently published by the Wetmore Reamer Company, Milwaukee, Wis. This publication includes illustrations, descriptions, dimensions and prices of Wetmore reamers, their parts, arbors, blades, etc. "Attention is called to the free cutting, accurate and extremely smooth reaming of these adjustable tools, and to the ease of making adjustments without the use of shims, screw drivers, calipers, micrometers or other tools. The particular feature, as noted by the principal illustration, is the left-hand spiral angle at which the blades are set. Among others listed are the solid reamer body, the graduated screw for expanding to thousandth of an inch, and the fact that these reamers may be attached to various styles and lengths of arbors. Standard size of reamers now made and vary from 1 inch diameter to 4½ inches."

"What Use is a Ship in a Dry Dock?" is the question asked in one of the bulletins published by the Ingersoll-Rand Company, 11 Broadway, New York. The bulletin goes on to state: "Its earning power has temporarily ceased, the work being done on it costs heavily, and the overhead charges—wages of crew, interest on investment, and all the rest—keep piling up. It's just the same with air tools. Excessive breakage and difficulty in repairing the tools necessitate a more extensive equipment and creates greater overhead costs. 'Little David' tools are made to reduce those expenses. They are so strong that the amount of repairs needed is extremely low. They are so simple in design that the time it takes to repair them is very short, and due to the interchangeability of various parts only a few spare parts need to be kept in stock. If you want pneumatic tools that stay on the job and keep out of the tool 'drydock,' equip your yard with 'Little David' pneumatic tools."

The Bolinders Oil Engine is the subject of a bulletin issued by Bolinders Company, 30 Church street, New York. "Bolinders engines make ideal power plants for oil barges and tankers. Their compactness, light weight, extreme dependability make them by far the most efficient propulsive power for boats of this type. What Bolinders engines have done and are doing for the Standard Oil Company they can do for you. The following Standard Oil Company's boats are Bolinders equipped: *Starlite, Moonlite, Twilite, Dawnlite, Sunlite, Daylite, La Merced, Oronite, Socony No.* 62, *Socony No.* 5, *Socony No.* 6."

Buffalo Fans, Blowers and Exhausters are described in Section No. 400 of the catalogue published by the Buffalo Forge Company, Buffalo, N. Y. "The design and structural details of Buffalo fans, blowers and exhausters are the result of practical knowledge gained by years of experience in the successful building and installing of this type of equipment for all purposes. The greatly increased use of fans in manufacturing and chemical plants for a great variety of purposes, together with the demand for better efficiency, has led to the development of new types and the improvement of others; in the progress of fan engineering we have occupied a prominent position, and in this and other catalogues we include information of much value to fan users."

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JEFFERY'S MARINE GLUE
In all the various grades it is the best for the money—the most serviceable. Pound for pound it will go further and do a better and a more lasting job than any other make. Do not be deceived by cheap imitations; see that the trade mark is on every package.
Send for booklets: "MARINE GLUE—WHAT TO USE AND HOW TO USE IT" and "HOW TO MAKE YOUR BOAT LEAK PROOF"
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ANDREW J. MORSE & SON
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receives the highest classification of the American Bureau of Shipping and Lloyd's Register of Shipping. It meets the requirements of all of the United States Government specifications. For years we have guaranteed the quality of each bale to be standard of excellence and returnable at our expense if otherwise. More of this grade Oakum has been used by the United States Government and its contractors than all other makes combined, yet, not a single bale has been condemned or rejected, whereas it has replaced the condemned Oakum of almost every other make. Our experience, quality and service are worth more to you than we ask.
GEORGE STRATFORD OAKUM COMPANY, **Jersey City, N. J.**

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TAPERED OR BEVELED LINERS OR FILLERS FOR SHIPS
IRVING IRON WORKS COMPANY, LONG ISLAND CITY, N. Y.
MAKERS OF IRVING'S SUBWAY (TRADE MARK) GRATING THE RETICULATED KIND

New Jersey Zinc

The world's standard for Zinc products

ZINC PLATES

Our numerous mines yield such a comprehensive variety of zinc ores that we are able to exactly meet every zinc requirement.

Our rolling mills at Palmerton, Pa., are now prepared to furnish zinc ship plates and boiler plates of any desired dimensions and thicknesses and of just the right quality to best serve their purpose.

This organization with its extensive resources and its seventy years of experience in the development and production of zinc products, has unusual advantages in meeting the needs of the ship building industry.

THE NEW JERSEY ZINC COMPANY, *160 Front Street*, New York

ESTABLISHED 1848

CHICAGO: Mineral Point Zinc Company, 1111 Marquette Building

PITTSBURGH: The New Jersey Zinc Co. (of Pa.), 1439 Oliver Building

Sootless Boiler Tubes are treated upon in a bulletin issued by Albert T. Otto & Sons, Inc., 101 Park avenue, New York. "Many devices have been invented to overcome the soot, but all were lacking in efficiency, due to faults in construction and method of operation, until the advent of the Atlas Soot Blower, which embodies the following points of efficiency: It cleans in the logical direction, viz.: with the draft and not against, thereby blowing the soot up the stack and not back on the rear plates; it is operated from the front, always under the eye of the engineer; it reaches every part to be cleaned with dry steam, and does the work thoroughly; there is no obstruction on the smokebox door, the handle being in position only when the blower is in use; it may be quickly, easily and economically installed, even when boiler is under full pressure; there is no decrease of pressure in using, as the entire operation only consumes about two minutes, and the results are almost instantaneous; when not in use it is telescoped into the tube (which is sealed) out of contact with the extreme heat; its saving in coal, and increase in speed of vessel, has proven on official tests to amount to 10 percent and over. An Atlas Soot Blower is absolutely essential where superheaters are used. Without one the tubes get sooted up immediately and the superheater is practically useless. Thousands of Atlas Blowers (under the English trade name) are now doing efficient service in the British Admiralty and Mercantile Marine, conserving coal, increasing heating surface efficiency and actual speed of ships. Naval authorities pronounce the Atlas the most efficient appliance of its kind yet devised. The British Admiralty is now using it to the exclusion of all other makes, and are taking practically the entire output of the English manufacturers."

Reversing Motor Planers are described in an illustrated bulletin issued by the Niles-Bement-Pond Company, 111 Broadway, New York. "The reversing motor drive as originally developed by us and which can be supplied on all Niles-Bement-Pond planers is a production booster on planer work that is reducing costs wherever in use. With drive direct from motor to table, extreme accuracy of stroke is assured. There is no over-travel. When motor stops, table stops. Motor is especially designed for quick reversal, and acts as a dynamic brake to stop table instantly and positively. We build machinery for ship shed equipment, all machines for the heaviest class of marine boilers, complete equipments for marine engine and steam turbine manufacture. These include steam hammers and electrical traveling cranes up to the largest capacity, as well as special machine tools for handling armor plate, guns and gun mounts. Extensive installations in Governmental and private shipyards and drydocks throughout the country speak for the quality and recognized merit of our products. We'll gladly send catalogues or give you any information or assistance in selecting equipment you desire."

Bradley Hammers for shipbuilders are described in a number of bulletins published by C. C. Bradley & Son, Inc., Syracuse, N. Y. "Did you ever stop to think that with a Bradley hammer a good man and proper dies you could make all your own punches and chisels right off the bar in your own plant and at the minimum of expense? Surest thing you know. These illustrations were taken from photographs of the actual articles thus made. The smaller punches can be made at the rate of probably 100 per hour, and the larger ones at the rate of 80 per hour and to 0.010 inch perfect at that. More accuracy, less quantity. 'A hammered' punch will beat a turned punch to death. The 'waste' of stock is practically confined to short bar ends, as the excess of metal from one punch goes into the next punch. You will have no 'turnings' for the scrap heap. Just cut off the punches under the hammer, grind cutting edge and temper. Simple, isn't it? Cold chisels, both hand, and for pneumatic hammers, made under the Bradley at the rate of 80 per hour. Just cut off, grind cutting edge and temper. Bradley hammers are rarely idle unless you have less work than they can do. Our more than forty-five years' experience in making hammers at your service.



ADMIRAL JELLICOE WAS WORRIED ABOUT HIS CONDENSER TUBES

He seemed to be more anxious over his condensers than over his 11-inch guns. The condenser tubes in many of his ships were in bad condition.

The regular commercial brand of tubing is NOT good enough for condensers. Special painstaking care must be exercised in manufacturing this product to do it RIGHT.

A few years ago we couldn't get the high quality condenser tubing we wanted, so we built a large mill and are now making our own. Wheeler Crescent Brand tubes are drawn and heat treated by EXPERTS IN CONDENSER WORK.

It will pay you to specify CRESCENT BRAND or order direct from our mill.

NO ORDER TOO LARGE OR TOO SMALL



During one month of this year we made and shipped nearly 1,000,000 pounds of condenser tubing—A RECORD.

Shall we put you on our tube department mailing list?

WHEELER CONDENSER & ENG. CO. CARTERET, N. J.

Manufacturers of:

Condensers; Centrifugal Pumps; Vacuum Pumps, including the patented Wheeler Steam Jet Air Pump; Evaporators; and all other condensing equipment for marine service.

38

Condensers and Auxiliaries are the subject of a very complete catalogue of 192 pages, published by the C. H. Wheeler Manufacturing Company, Philadelphia, Pa. This catalogue is profusely illustrated and constitutes almost a text book on the subject. We quote in part from the introduction: The advent of the steam turbine, operating either high pressure or completing the expansion of steam begun in a reciprocating engine, has brought with it the demand for high vacuum. The necessity of producing vacua of 28 and 29 inches within reasonable limits of size and operating cost has revolutionized condenser practice, with the result that modern condensing machinery is far in advance of that of a few years ago. As the function of a condenser is to increase the economy of a power plant, it follows that the selection of the most suitable apparatus is by no means merely a question of first cost. The important points to be considered are economy in maintenance charges, low operating cost and reliability. Operating cost is a very large item and differs widely with different types of condensers, viz., jet, barometric and surface. Other points to be considered are the load factor of the turbine or engine, the cost and net lift of the water used, the location of the plant and the use or non-use of a water cooling tower. As explained in another chapter, the cooling tower may frequently prove the deciding factor in the choice of a condenser. Condensers of the same general type necessitate the consideration of the parallel flow and counter-current principles, arrangement of tubes and baffles, direction of flow of the steam, together with the type and efficiency of the feed-water heater, all of which affect the economy of the performance."

The De Laval Oil Purifier is described in a circular published by the De Laval Separator Company, 165 Broadway, New York. "The use of the De Laval oil purifier eliminates the pitting of cylinder walls. The use of low-priced, high-sulphur fuel oils in Diesel and semi-Diesel engines has its main drawback, in that sulphuric acid is formed, which rapidly attacks and pits the walls of the cylinders and cylinder heads. These high sulphur oils invariably contain a certain amount of water. During the combustion of the fuel charge the oxidation of the sulphur forms sulphur dioxide (SO_2), and this sulphur dioxide unites with the water, forming sulphurous acid (H_2SO_3). This acid unites with oxygen, forming sulphuric acid (H_2SO_4). The De Laval method of purification dehydrates this oil, thus eliminating any possibility of sulphuric acid being formed. It is therefore a necessity wherever high-sulphur fuel oils are used. Please ask nearest office for further information on centrifugal dehydration of high-sulphur oils. The knowledge and experience of our experimental department are at your service."

Pumps for Marine Service are described and illustrated in a catalogue just issued by the Morris Machine Works, Baldwinsville, N. Y. "No ship's equipment is complete without a Morris pump installation. It plays a very important part in procuring the highest efficiency in every ship's power plant. Extreme simplicity of construction, reliability and low operating cost are only a few of its many advantages. Morris pumps may be used for furnishing the ship's water supply or for surface condenser systems. Built in all sizes for belt, direct connected, steam or electric drive. Our catalogue of Morris pumps describes fully our complete line of centrifugal pumps, hydraulic dredges and steam engines. Write for it."

Steam Gongs that are especially adapted for fog signals are among the steam specialties described and illustrated in a catalogue published by the Union Water Meter Company, Worcester, Mass. "Our steam gongs are different from ordinary steam whistles and produce an immense volume of sound, which, while soft and pleasing nearby, extends over an incredibly large range. We have authentic reports of these gongs having been heard over distances upwards of twenty miles. The two larger bells produce the volume and power of sound to cover long distances, while the small bell has the penetration necessary to be heard above nearby noise."

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Murray Steam Power Plants are the subject of Catalogue 85, published by the Murray Iron Works Company, Burlington, Ia. "The advantages of buying the engines, boilers, heaters, pumps and piping of one company are obvious and numerous; you get a harmonious whole that can be obtained in no other way. Consider the correspondence and the sending of drawings back and forth between the purchaser, the engine builder, the boiler maker, the heater man, and the pump and piping people that are necessary in order to make the connections between them. Consider also the delays that ensue and the inconveniences of having the parts that are wanted first come last, and figure the unnecessary and extra freights that have to be paid. Imagine how each manufacturer will blame the other for any trouble or deficiency or failure to perform, and generally prepare for grief if you buy your power plant piecemeal. On the other hand, count the advantages of being able to buy the best kind of an engine—either Corliss or slide valve—and the best boilers and heaters from one responsible company that will take an equal interest and pride in both the engine and the boiler, and whose different departments, while competing with each other for excellence, are yet co-operating heartily. The parts will fit each other, they will be of harmonious proportions, they will be shipped in proper order, and can often go on one car, and one erecting engineer can superintend the whole job."

A General Catalogue and price list is issued by the Kennedy Valve Manufacturing Company, Elmira, N. Y. In compiling the catalogue the company has endeavored to present all essential features in a simple and at the same time comprehensive manner. 122 pages; illustrated.

"Labride" Reaming and Countersinking Machines are described in Bulletin 201, published by the Lakeside Bridge & Steel Company, North Milwaukee, Wis. The catalogue describes the machine as follows: "The machine consists of a movable trolley mounted on a 16-foot boom, constructed of structural shapes, which in turn is supported on cast iron wall brackets. Length of boom can be made to suit conditions. When used as a radial drill this machine has many advantages over the ordinary radial. It has a wide possible range, takes up little space, and when not in use can be swung out of the way. The trolley is rigid and moves with extreme ease from end to end of arm. The feeder lever is counter-weighted, and can be adjusted to allow moving spindle vertically without excessive energy on the part of the operator. The trolley consists of a cast iron frame upon which a motor of ample size is mounted. The gears are connected direct to motor, and the bevel gears which drive main spindle run in an oil bath, thereby insuring minimum wear. Three ranges of speed can be had through gear changes. The three speeds of main spindle are approximately 80, 115 and 170 revolutions per minute. The main spindle bearings are bronze bushed. Other bearings are babbitted with a good grade of babbitt. All gears are cast steel; pinions are forged steel; all teeth are cut from solid metal; shafts are cold-rolled steel. The spindle has a vertical movement of 11 inches, and has a five-point adjustment, which gives an additional 11-inch adjustment vertically. The spindle is bored for a No. 4 Morse taper shank. A capable operator can drill on the average of 125 7/8-inch diameter holes per hour through 5/8-inch metal, and ream or countersink 250 to 300 holes per hour. All gears outside of main frame are guarded to prevent workmen from coming in contact with moving parts. Collector wires are guarded by a metal cover. This machine can be equipped with either alternating-current or direct-current motors. Current is collected from wires which are installed on side of channel boom. These wires are enclosed. We can make delivery in four to eight weeks, depending upon conditions in our shop at the time of placing order and the delivery we can get on the motor. We have several machines in our shop, and have sold them to various shipbuilding and structural plants over the country. In all instances they have proved to be an efficient labor-saving machine."

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De Laval Gears and Turbines are described in Catalogue M-46, just issued by the De Laval Steam Turbine Company, 400 Nottingham Way, Trenton, N. J. "The design is based upon an experience of 25 years in building double-helical gears for steam turbine service. Special machine tools and special methods have been developed by us to secure the absolutely correct tooth angle, shape of tooth and pitch which are necessary to give even contact surface over the whole length of the tooth, and which are absolutely essential to noiseless, efficient and vibrationless operation. De Laval gears and turbines are built of the best materials by highly skilled workmen, working on a limit-gage and interchangeable basis. The success and long life of the hundred of De Laval gears in daily operation show that De Laval gears are correctly proportioned, accurately cut and maintained in correct alignment by the De Laval design of gear case and bearings. The De Laval geared turbine constitutes the most simple, compact, efficient and reliable power unit."

The American-Thompson Improved Indicator is described and illustrated in a 32-page catalogue published by the American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass. "Full credit is due and freely given to the late J. W. Thompson for having invented and perfected the only flawless indicator known, the American Thompson Improved Indicator. The American Steam Gauge Company was the original manufacturer, and is to-day the sole owner of the supplementary patents to the genuine J. W. Thompson indicator. The steam gage and safety valve, of which we were the first and are to-day the largest manufacturers in the United States, were the most important inventions in the development of steam power, but the indicator is more wonderful than either, in that it shows absolutely the exact conditions of pressure within cylinders, and permits of adjustments which not only insure an economical use of steam developed, but at the same time, by the corrections thus effected, add greatly to the life of the engine."

The Sprague Adjustable Loop System of Overhead Material-Handling Machinery for terminal sheds is described in Bulletin 48713, published by the Sprague Electric Works, 527 West Thirty-fourth street, New York. "This bulletin is devoted to a description of the function, operation and construction of an overhead mechanical system for handling miscellaneous and bulk freight and materials in terminal sheds. This system is known as the Sprague Adjustable Loop System, because the overhead track on which the hoisting and conveying machines are operated is in the form of a continuous, unbroken loop, which is adjustable in length. The adjustable loop system is applicable to terminal sheds for the temporary storage of freight or material before loading or after unloading from ships, barges or railroad cars. The primary purpose of the system is to speed up the movement of freight in the shed, to reduce the cost of handling it, to utilize the shed space to the fullest extent, to speed up unloading and loading and to relieve congestion at loading and unloading points. In some applications it is used directly for loading and unloading, in others only for handling in the terminal sheds."

A Locomotive Crane of from 20 to 30 tons capacity is one of the large line of cranes made by the Edward F. Terry Manufacturing Company, Grand Central Terminal, New York. Bulletin No. 2 describes this crane and calls attention to the following improved features: "All clutches are of extra large size and of the inside band brake type, which has proved its superiority over all other forms of clutches in power transmitted, ease of adjustment and low cost of maintenance. The levers operating the clutches are designed so that the mechanism is free from eccentricity and unbalanced thrusts, thereby making the work of shifting easy for the operator and at the same time reducing to a minimum the wear of these most important parts of the crane. The heavy stresses between the rope tackle and the car trucks are carried throughout by structural steel, which has been found more reliable and more capable of standing hard usage than cast iron or cast steel. The turntable is prevented from tipping by the use of rollers bearing against the underside of the base ring, rather than by the center pin, as is the usual practice. By the use of center as well as end outriggers of the telescopic type, exceptionally heavy loads may be safely handled. The boom-hoisting drum is driven by means of a train of spur and bevel gears, of which the friction is so much less than the worm gear ordinarily used that the boom may easily be raised with full load on the hook. The boom-hoisting drum is equipped with an automatic holding and lowering brake of the inside band type, whereby the boom is positively held in position and is under complete control of the operator at all times. The brakes for the main drums are so arranged that the speed of operation and safety are very much increased by means of a device which allows the load to be hoisted while the brake is set. Special attention has been given to the arrangement and location of the operating levers so that the operator has the best possible view of the work which he is performing. The crane has a nominal capacity of handling a 20-ton load at a radius of 12½ feet without the use of outriggers, and 30 tons at 12½ feet radius with center and end outriggers. Its capacity, however, varies with the radius and length of boom used."

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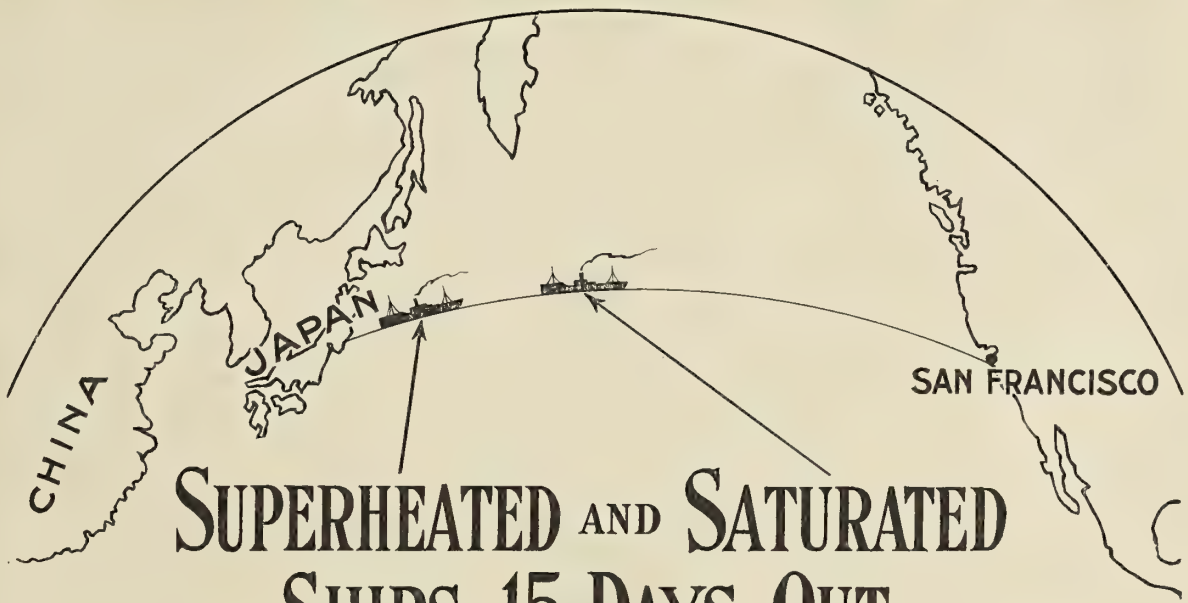
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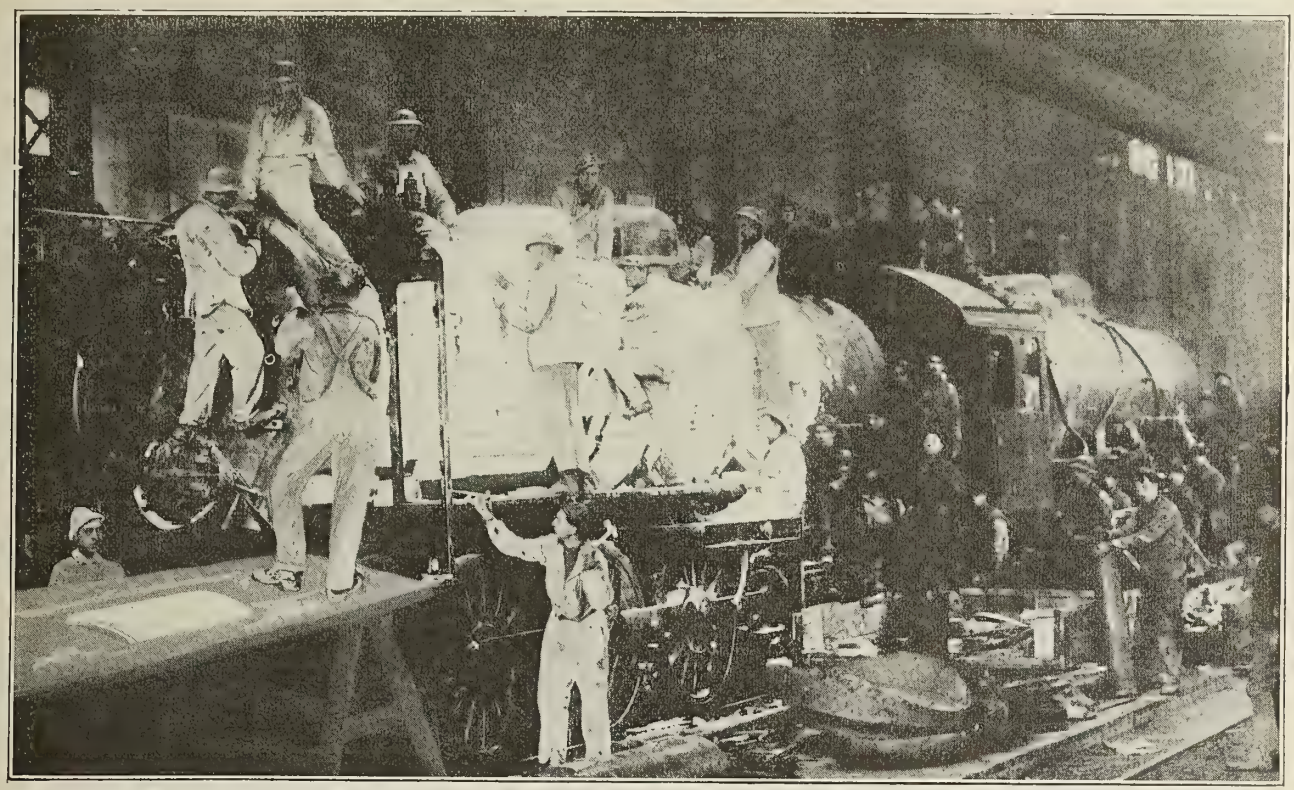


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WHEN our doughboys in France heard the deep-throated whistle of the American locomotives, instead of the shrill squeak of the French locomotives, they said, "That sounds like home."

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TRADE PUBLICATIONS

An Interesting Comparison between the old Scotch marine boiler and the Heine watertube boiler has been written by Charles H. Stoddard, consulting marine engineer for the Heine Safety Boiler Company, St. Louis, Mo. Two boilers of approximately the same capacity are illustrated. One is a Scotch marine boiler, 14 feet 9 inches in diameter, containing 2,700 square feet of heating surface and built for 210 pounds working pressure. The other is a Heine marine watertube boiler, also containing 2,700 square feet of heating surface, and built for a working pressure of 225 pounds per square inch. "The Scotch boiler is fitted with 3-inch tubes and the Heine boiler with 3½-inch tubes. Both are suitable for either coal or oil fuel, but are here considered as fitted for oil burners. To the weights given for the Scotch boiler must be added 7 tons to cover the difference in weight of breechings, fire fonts, boiler mountings, lagging, retarders, etc., which are either included in the weights given for the Heine marine boiler or are unnecessary. Cargo steamers, such as have been recently built for the Emergency Fleet Corporation, are each equipped with three boilers. The weights involved are therefore 253½ tons for the Scotch boiler installation against 162 tons for the Heine watertube installation—a saving in fire-room weight by the use of Heine marine boilers of 91½ tons. An actual possible increase of paying cargo capacity of approximately 100 tons should be of interest to any steamship owner. Some watertube boilers are even lighter than the Heine boiler. It is stated by the Heine Safety Boiler Company that they also could make the Heine boiler lighter if extreme light weight were believed advisable. However, that argument has no place in this article. The Scotch boiler is held in esteem by many engineers because of the large volume of water it contains ready to turn into steam the instant a greater demand for steam is made upon it. This is a reservoir of power that tends to reduce fluctuations of pressure in operation. The manufacturers of the Heine boiler recognize the value of this reservoir of power. They do not approve boilers of the ultra light weight type, therefore they fit their boilers with waterlegs 11 inches deep instead of 5 inches or 6 inches. These waterlegs have not been stinted either in height or width, nor are they broken up into numerous 'headers,' nor is their capacity reduced by partitions and obstructions. The capacious waterlegs are stayed with screwed staybolts, from which, within the water space, the screw threads have been carefully removed. As for comparative cost, one has but to look at the illustrations. Note the 1 9/16-inch and 1¼-inch plates, the great weight of high-priced steel, and the many costly flanged heads used in the construction of the Scotch boiler, and note that the few plates used in the watertube boiler for higher working pressure are but ½ inch and ⅝ inch thick. After one notes these points he realizes why the cost of the Scotch installation exceeds often by as much as 50 percent the cost of a watertube installation."

Rich Twist Drills are described by the Rich Tool Company, Chicago, Ill., in a bulletin just issued. "Locomotive, automobile, aeroplane, gun and machine parts, subject to maximum shocks of great frequency or torsional strains are first forged. Why? Because forging increases their physical properties—rearranges the structure to withstand stresses in any desired direction, and gives each portion the required amount of working. At the proper temperature the flutes of Rich tools are first forged and twisted. The result is a blank thoroughly uniform in every part and of superior physical properties to the bar from which it was made. Not welded, brazed or built up—made in one piece of the most suitable and best high-speed steel of the proper composition—every operation and process is conducted with care and judgment. It is unnecessary to tell you that this drill will produce maximum service—it is built for it. Taper shank, standard and over-size; straight shank, long and short set; high-speed bridge reamers, countersinks, track and bonding bits, rivet sets, etc."

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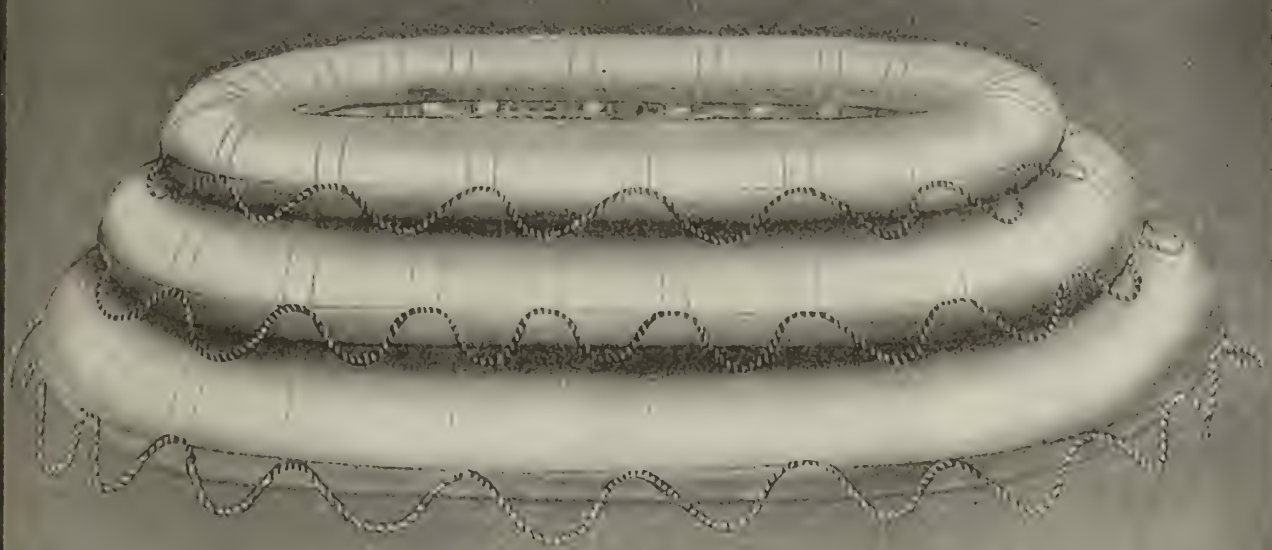
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For a great many years we have specialized in the manufacture of the highest grade of marine lifesaving equipment such as:

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Lundin Motor Lifeboats
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Metallic Cylinder Life Rafts
Mills' Releasing Gear
A. B. C. Life Rafts
A. B. C. Life Preservers
A. B. C. Ring Buoys
Welin Gripe Release
Welin Non-Toppling Blocks

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Catalog on Request

AMERICAN BALSA COMPANY, Inc.

Welin Marine Dept. **50 E. 42nd Street, New York**

London House: 5 Lloyds Avenue, London, E. C.

Pump Data Bulletin No. 102 has just been published by the Aldrich Pump Company, 30 Church street, New York. "This data is by no means complete as to our lines of effort, as there is an Aldrich Triplex or Quintuplex Pump for every industrial, engineering or mining purpose. Separate pump data is issued, and will be mailed upon request, stating service intended for. We solicit correspondence in relation to all pumping problems, and our engineering salesmen are ready to call and give personal attention, also make recommendations covering the most suitable and economic equipment for the work to be performed."

How to Keep Boiler Tube Caps in Prime Condition is told in Booklet 75-D, published by the Joseph Dixon Crucible Company, Jersey City, N. J. "The way to do it is to smear them with Dixon's graphite pipe joint compound before replacing. This compound never 'sets' or hardens like cement. The caps can be removed and replaced whenever desired without the slightest trouble. It will never be necessary to regrind them to get a steam-tight fit with the seats. Dixon's graphite pipe joint compound is equally valuable for all threaded or flanged joints, for bolts and nuts of all kinds, metal gaskets, etc. It makes the tightest joints, prevents rust and corrosion, and does not get hard or brittle. For more complete information write for Booklet No. 75-D."

"The Trackless Train" is the title of a 16-page illustrated booklet issued by the Mercury Manufacturing Company, 4118 South Halsted street, Chicago, Ill. "To define the Mercury tractor from the point of use, it is only necessary to say that it is designed to pull trackless trains of trailers without the limitations as to pathway which constrict such devices as the industrial railroad or the belt conveyor. Instead of carrying it is designed to pull or push loads. With respect to construction, it is a trackless locomotive driven by an electric motor which obtains its current from storage batteries contained in the body of the tractor. In aiming to make it useful in industries where it must work in narrow aisles, difficult alcoves, tunnels and doorways, the Mercury tractor is designed to have a compacter body and a smaller turning radius in proportion to its battery capacity than any similar device. The function of the Mercury tractor is to introduce a more efficient and economical method of materials-handling. What the Mercury Manufacturing Company introduces into industry, therefore, is not an apparatus, but an efficient and economical system of transportation, supplying at the same time the power unit that makes the system possible. Mercury tractors are not merely machines, but power units of a transportation system from which they cannot be dissociated."

The Electro-Hydraulic Steerer, made by the American Engineering Company, Philadelphia, Pa., is described in a circular just issued. Following are some of the claims made for this steerer: "It is absolutely reliable and positive in action; extremely sensitive and prompt in starting; ample in holding power and provided with positive relief against rudder shock; mechanically efficient and requires minimum attention; flexible as to arrangement about the rudder stock; compact, requiring less space than any other steerer of like power; the nearest approach to the ideal steerer."

Hydraulic Presses for bending pipe, rods, etc., are described and illustrated in Catalogue 98, issued by the Watson-Stillman Company, 36 Church street, New York. One of the illustrations shows one of the company's large line of presses for bending and straightening operations. "This machine works on a water pressure of 1,500 pounds per square inch. The pins are interchangeable in any of the holes. The ram is double ended, and is actuated by two cylinders, enabling the operator to exert force from either side of the table. The valves are placed in one body, and connecting levers at either side of the press govern the movements completely. We build hydraulic presses for every purpose where hydraulic pressure is a possibility; also pumps, accumulators, valves, fittings, packings, shears, riveters, punches, jacks, frame benders, etc."

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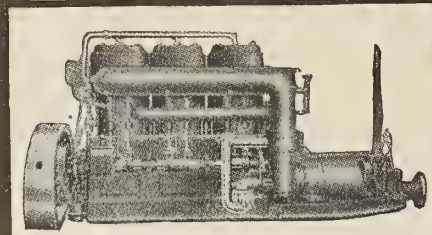
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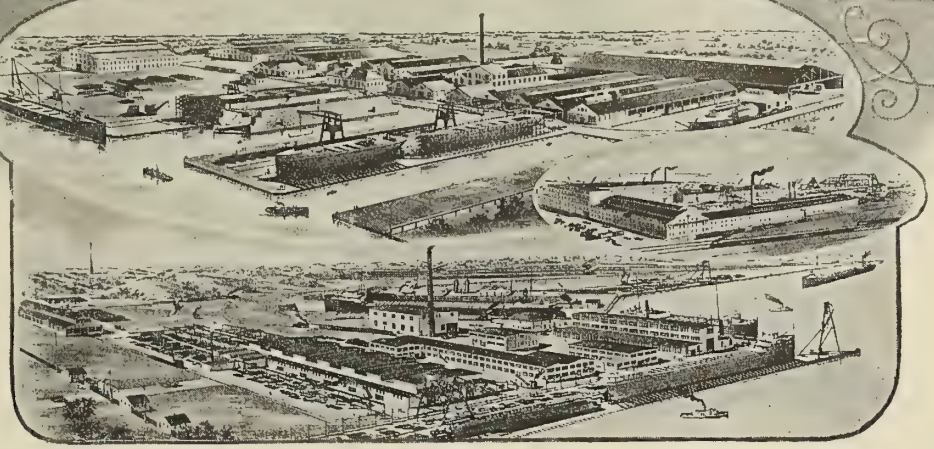
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Great Lakes Engineering Works



Steel Ship and Engine Builders

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Over sixty steel ships have been built by us for over sea trade and forty-eight are now under construction.

Kingsbury Thrust Bearings are described by Albert Kingsbury, Pittsburgh, Pa., in a profusely illustrated catalogue of 36 pages just published. The principle of operation is explained in part as follows: "The Kingsbury bearing floats the load on a film of oil which completely separates the bearing surfaces without employing a high-pressure oil pump. The bearing forms its own oil film automatically. Its principle of operation is as follows: Consider a flat metal table with a ledge around it and containing oil to a depth of a quarter inch; if a rectangular metal plate supporting a weight is placed in the oil the plate will sink and squeeze out practically all the oil between it and the table. If, however, the plate is pulled along the table by a horizontal force it will tilt up at the advancing end, and move along in that position, floating on a thin, wedge-shaped film of oil, whose mean thickness depends on the load, speed, viscosity of the oil, proportions of the plate surface, position of the load on the plate, and apparently not at all on the kind of metal used. Since the load is floated on the oil it is evident that the sum of the upward pressure within the liquid must equal the load supported. The mean pressure is easily calculated. The actual pressure varies from nothing at the edges of the plate to a maximum about under the center of the load. This maximum is approximately twice the mean pressure. The friction or force necessary to move the loaded plate along as it floats on the oil film depends upon the velocity, the viscosity of the oil and the film thickness. The mean thickness of the film might easily be a thirty-second of an inch for a light load moving at very high speed on a medium grade of oil. A heavy load at low speed might thin the film down to less than a thousandth of an inch. There is a certain place on the floating plate that will support a greater load than any other. There is another place, almost coincident with the above, where a given load may be placed and floated on the film with a minimum of friction. These places are behind the center, looking from the advancing edge, *i. e.*, at a point about 60 percent of the length of the plate from the advancing end."

The New Steering Gear Catalogue just issued by the American Engineering Company, Philadelphia, Pa., is a handsomely printed and illustrated booklet of 28 pages. The introduction reads as follows: "For more than fifty years the American Engineering Company and its predecessors, the American Ship Windlass Company and Williamson Bros., have been developing a line of marine auxiliary machinery, the chief characteristics of which are reliability, durability and accuracy of operation. The scope of these products does not permit detailed discussion of all the variations which could be made to meet peculiar conditions. Our aim, therefore, is to give concise descriptions and information which will enable customers to determine the general characteristics of the various types of equipment. Special problems should always be the subject of consultation. We shall be pleased to assist at any time in their solution as regards the selection or adaptation of any of our products. To keep pace with the rapid advance of marine auxiliary equipment, our engineering department is constantly studying to better our standard machinery or perfect new types which show improvement over the old. Hence some of the illustrations in this catalogue show designs superior to those in our last edition. On the following pages we briefly describe our standard line of steering gear, a subject of utmost importance to the safety of the ship. Generally speaking, the subject of steering gear is divided into three groups: Hand steerers, transmission systems and power steerers. Each of these groups serves a particular function in connection with steering."

The Babbitt Adjustable Sprocket Rim with Chain Guide, adapted especially for marine use, is described in a circular issued by the Babbitt Steam Specialty Company, New Bedford, Mass. The Babbitt adjustable sprocket rim with chain guide has become the most important factor for simplifying piping arrangements, reducing danger and expense, and in making out-of-the-way valves convenient to operate from the floor. The Babbitt appeals strongly every heating plant owner, to operating and consulting engineers, architects, contractors, building superintendents, and all others who have to do with valves and piping."

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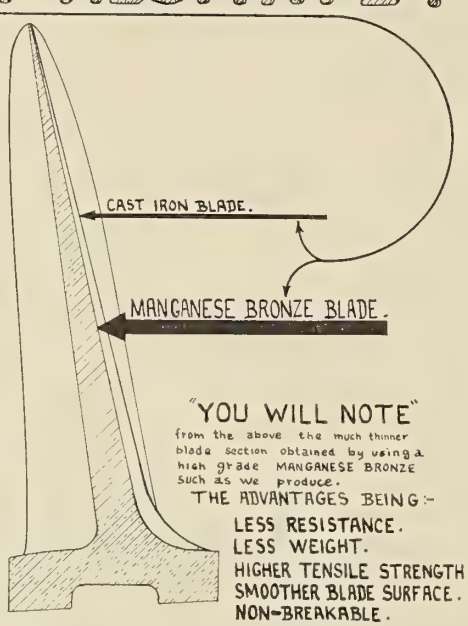
Plate casters for handling large and awkward shaped plates between the various operating units of a plant are described in a circular published by the Hart Roller Bearing Company, Orange, N. J. "Shipbuilders are confronted with the problem of handling and routing large and often awkward shaped plates between the various operating units of the plant. This problem is solved by short pipe standards being attached to the floor surrounding the shearing, punching and forming presses, on top of which are mounted Hart universal plate casters. Big cumbersome plates can be transported throughout the plant with the utmost speed, convenience and economy. Direction of movement may be changed instantly without undue friction or marring of the work. Hart universal plate casters have only six parts—base, three roller bearings, ball and cover, which fits close and excludes all dirt. Stock sizes have 3-inch and 4-inch balls, but we are prepared to meet special requirements. Float your plates where you want them."

"The Importance of a Strong Constitution" is the title of a circular issued by the Coes Wrench Company, Worcester, Mass. "A man who is sick most of the time cannot accomplish much—nor a wrench—both must have a strong constitution. Just as each part of the human body must contribute its share of strength, so must each part of a wrench unite with the other parts for this same accomplishment. There must be no weak parts. Coes 'Steel-Handle' Wrench is a good example of how strong and serviceable a screw wrench can be made when useless parts are eliminated. With a constitution made up of six solid, simple whole parts, all united by the strong Coes method, there isn't a sign of weakness in a Coes steel wrench anywhere. These two models are especially made for trying service, in moisture (hot or cold) and for heavy duty."

"The One Gas of Universal Service" is the title of a circular published by the Prest-O-Lite Company, Forty-Second Street building, New York. "What factory man, having to provide a source of power for his plant, would deliberately choose to install different types and kinds of prime movers for each department? Only the most unusual operating conditions could drive him away from a centralized power service, with its obvious economies, flexibility and certainty of supply. The same powerful considerations apply in choosing a gas supply for your blowpipe operations. There is only one process which meets all blowpipe requirements with the greatest working efficiency and lowest cost—oxy-acetylene. Whether it be a light soldering or brazing job or the heaviest welding or cutting, the ideal means is Prest-O-Lite dissolved acetylene—the universal gas with the universal service. Acetylene in its purest form is thus available to you, chemically dissolved so that you get a large quantity in small bulk. Only one stock of cylinders, one kind of gas, one kind of operators and equipment—oxy-acetylene. Presto-O-Lite service and the plan under which users enjoy it is an important matter to metal workers and factory operators. War demands forced the growth and development of years into months. There are more Presto-O-Lite plants, more cylinders, than ever before. There's an efficient, well-stocked source of supply in most every industrial center; plants and warehouses in 35 cities."

"Spraco" pneumatic painting equipment for shipyard use is described in an illustrated bulletin issued by the Spray Engineering Company, Boston, Mass. "There are numerous concerns that employ the most efficient systems in many departments, but still use the slow, inefficient hand and brush method of painting. This is certainly inconsistent. Spraco pneumatic painting equipment is rapidly supplanting the other time-worn methods all over the country, because one man with the Spraco outfit can do the work of half a dozen men using brushes. And Spraco insures a better job, every crack and crevice, every irregular surface, every part inaccessible to a brush, is smoothly coated with the Spraco paint gun. Spraco equipment raises your painting to the same efficient plane of the rest of your departments."

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If you want STRENGTH use Manganese Bronze . . .
If you want the STRONGEST, use S.M.B. Brand

"YOU WILL NOTE"
from the above the much thinner blade section obtained by using a high grade MANGANESE BRONZE such as we produce.
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NEW YORK BELTING & PACKING CO. FOUNDED 1846 INCORPORATED 1856

The Automatic Compensator made by the Electric Controller & Manufacturing Company, Cleveland, Ohio, is described in an illustrated folder just published. "When you push the start button the operating coil in the automatic compensator is energized, and contacts are closed connecting the motor to the current supply lines through the transformer in the compensator. This gives reduced voltage to the motor and causes it to start up with the proper amount of current and no more. When the motor has reached the proper speed so that it can be safely thrown directly onto the supply line the automatic compensator will do this, and it will never do this at the wrong time. This leaves nothing to the judgment of the operator. All that he or she needs to know is when to start the motor and when to stop it. It is unnecessary to state that the only operation required to stop the motor is to push the stop button. The E. C. & M. automatic compensator works under oil. Do you realize what that means? In the first place we recommend that the automatic compensator be inspected at least once a year. Have you any electrical equipment that you inspect only once a year? All circuits are made and broken under oil and all arcs are extinguished by the oil. All moving parts are perfectly lubricated, as they work in oil. As a result the E. C. & M. automatic compensator can be used in the presence of inflammable gases. It can be used in dirty or dusty places. It can be used outdoors or can be used indoors where steam or other vapors are present. Acid fumes will not hurt it, because they can't get at the vital parts."

Dynamic balance obtained by a new machine built on a new principle is described by the Crawford Tool & Manufacturing Company, 1617 South Crawford avenue, Chicago, Ill. "For the solution of all vibration troubles as found in flywheels, pulleys, propellers, turbine rotors, separator discs, gear wheels, fans, all kinds induction rotors, connecting rods, clutch parts. This machine will show the exact amount of the counterweight required and the exact circumference plane where the counterweight should be taken off or added on."

Reflex Water Gages are described by the Jerguson Gage & Valve Company, Winter Hill, Somerville, Mass. "Advantages: Quick and reliable observation of the water level; safe, sure and durable at high pressures; not affected by cold air drafts; most effective protection against injuries to boilers and workmen; easily applied to all types of gage glass fittings. When filled with water the reflex gage always appears black; when empty it instantly shows white; no mistake possible. This feature alone is worth many times the cost of the Reflex. Send for catalogue of water gage apparatus."

The "Midwest" marine oil engine is described in a catalogue published by the Midwest Engine Company, Indianapolis, Ind. "From low-cost crude and fuel oils—the highest known efficiency for boat propulsion or auxiliary. Clutch type and directly reversible marine oil engines. Here is the Midwest-Diesel directly reversible marine oil engine—a brute for strength and a wizard for economy and efficiency. Among its distinctive features is the open crank case, that affords the utmost convenience for inspection and adjustment. Pistons, with their rings, are removable without dismounting the cylinder heads or connecting rods. Simple, positive control for maneuvering ahead and astern guarantees extreme flexibility of operation."

The Reilly Distiller is described and illustrated in Bulletin 228 just issued by the Griscom-Russell Company, 2124 West Street Building, New York. "The purpose of a distiller is to condense all or a part of the vapor from the evaporator to provide pure drinking water on shipboard. The Reilly distiller is a special type of condenser taking clean vapor, preferably from the evaporator, and condensing it in copper coils, thus insuring pure water. The construction is such that there is absosolutely no possibility of the circulating water leaking into the distilled water chamber. It is readily seen that this is an important feature when using harbor or sea water for condensing."

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  - Heavy oil (Diesel)
  - Producer Gas

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- Steering Engines
- Capstans
- Windlasses
- Boat Cranes
- Anchor Engines
- Ash Hoisting Engines
- Towing Engines
- Ventilating, Heating and Cooling Apparatus
- Sirens and Whistles
- Fire Extinguishing and Fumigating Apparatus
- Reducing Valves
- Regulating Valves

1067 pages. The book is illustrated with 550 diagrams and cuts, showing the most approved practice in the different branches of the subject. The text is in such plain, simple language that any man with an ordinary education can easily understand it.

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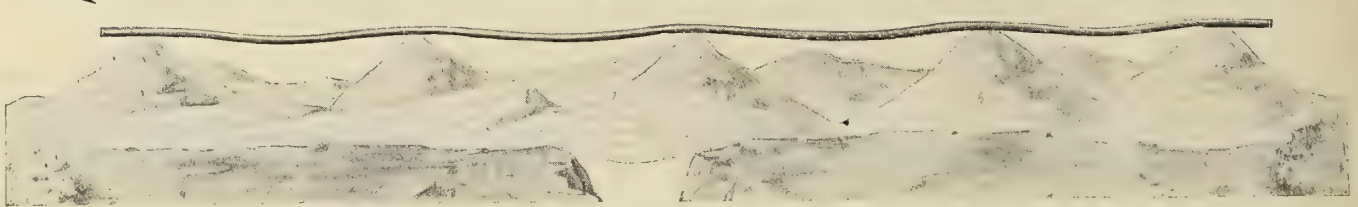
Irving "Subway" Grating is described and illustrated in a 36-page catalogue issued by the Irving Iron Works Company, Long Island City, N. Y. This grating is stated to be especially valuable for use in steamship boiler and engine rooms, for stair treads and similar purposes. "Briefly summarized, Irving Subway offers the following exclusive advantages over any other form of grating or grating flooring: Maximum strength per unit of weight; minimum weight per unit of load and span; uniform distribution of load by truss construction; minimum deflection per unit of load and span; maximum lighting and ventilation area (80 percent of panel area); absolutely non-slipping surface; cannot become loose and rattly; oil or grease, ice or snow, age or wear do not impair its non-slipping qualities; minimum lodgment for dirt or solid objects; small size of individual openings (mesh) prevents passage of tools, etc.; wheels or rib-hooped barrels can be rolled over it in any direction without going through; its light weight means minimum weight and cost of the supporting structure; safe, comfortable and noiseless to walk or work upon; safe to work under, because nothing large and heavy can fall through it; openings for pipes, columns, etc., can be cut out without seriously impairing the strength of the panel; easily fitted into corners or formed in irregular shapes without impairment of strength; while affording maximum opening for lighting and ventilation, the depth of the bar members obstructs vision except when directly beneath; easily mounted or attached to any type of construction by means of specially devised fasteners—no drilling, no tapping, no bolts or screws needed."

Shipbuilding Cranes are described in Bulletin No. 40, just published by the McMyler Interstate Company, Bedford, Ohio. This is a handsomely illustrated catalogue of 50 pages. We quote as follows from the introduction: "This bulletin contains data and illustrations of various types of cranes in use in the shipbuilding industry. In order that this equipment will serve its purpose to the best advantage, it is necessary to properly co-ordinate the design, capacity, sphere of operation and speeds. This necessitates a careful study of yard layout and future extensions. The most efficient shipbuilding plant launches the greatest tonnage in equal periods of time per foot of shipbuilding ways, comparisons being based on work in the same classification. The data which is given in this bulletin is representative of present-day practice and can be accepted as an index to successful equipment for ship construction. The McMyler Interstate Company will appreciate every opportunity to confer with shipbuilding companies, naval architects and ship owners' repair docks in regard to crane requirements."

The Sprague Electric Dynamometer is described in Bulletin 48701-A, just published by the Sprague Electric Works, 527 West Thirty-fourth street, New York. "The Sprague Electric dynamometer is recognized as the standard laboratory equipment for the testing of internal combustion engines by manufacturers, technical schools and in United States Government experiment stations. Starting with one installation in 1906, several hundred Sprague electric dynamometers are to-day in use. They have played an important part in the development of automotive apparatus, not only for peace time uses but for uses in the great war. This bulletin is devoted specially to the Sprague electric dynamometer as applied to laboratory and production testing of automobile, truck, tractor, airplane and marine gasoline and kerosene engines. Some of the many other applications of the Sprague electric dynamometer are described in other bulletins. The Sprague electric dynamometer is a machine for measuring torque. The engine in test is coupled to the internally revolving rotor of the dynamometer, which transmits the full torque exerted by the engine to the external field or oscillating frame by electromagnetic interaction. The oscillating field frame is balanced on ball-bearing pedestals, and is restrained from revolving by the scales on which the torque is measured."

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CRESCENT BRAND

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CARTERET, N. J.

Manufacturers of Brass Goods; Brass and Seamless Copper Tubings; Plates; Sheets; Condensers; Centrifugal Pumps; Vacuum Pumps; Cooling Towers; Feed Water Heaters; Evaporators; Exhaust Relief Valves; etc. 35

Special Shearing Equipment for the boiler shop is described and illustrated in a circular published by Joseph T. Ryerson & Son, Sixteenth and Rockwell streets, Chicago, Ill. "The Lennox rotary splitting shear, housing type, is designed for straight shearing of sheets and plates, but will also cut round, square or flat bars of a diameter or thickness corresponding to the capacity of the tool for plates. The blades are milled, making them self-feeding, and are reversible. The main frame is offset so that plates of any length may be split without distortion. The extended upper shaft carries a hold-down wheel to guide the plate and prevent it from tipping. This, together with the enclosed form cutter shaft, which operates at rest, materially assists the operator and makes unnecessary the use of a hoist and an extra helper. Machines are made in regular sizes of 4, 6 and 8 feet between housings. Special sizes can be furnished to order. The Lennox rotary bevel shear has long been recognized as a necessary part of the equipment of the modern boiler and tank shop, at the present time there being in use several thousand of these machines, embracing practically all of the principal boiler, tank, railroad, car and shipbuilding plants of the world. This machine will bevel all of the regular and curved sheets usually required in boiler and tank construction. It will bevel-shear in-and-out curves of segments, angles, and such difficult work as boiler heads after flanging, manhole saddles, dome sheets, and in addition will handle straight work in a small proportion of the time in which it can be done by hand or on a plate planer."

"Hercules" High-Speed twist drills and reamers are described in Catalogue 91 just issued by the Whitman & Barnes Manufacturing Company, Akron, Ohio. "Put a good man behind a 'W & B' and your combination can't be beat. With 'Hercules' (patented) high-speed twist drills and reamers, holes come fast and accurate in the hardest, toughest steel. The shipyards that produce the most good holes per drill and per dollar of drill cost regularly use 'Hercules' high-speed twist drills and reamers on bottom, keel and deck plates, stern posts and general heavy work. 'Hercules' twist drills have a collar larger than any other part of the drill—prevents dropping through a finished hole. They are hot twisted from special rolled alloy steel—keeps the original grain of the metal. Thin webs result in fast, clean work. 'Hercules' (patented) high-speed reamers keep pace with 'Hercules' twist drills. Other 'W & B' tools for shipbuilders include our three-lip ship plate countersinks, a fine set of spud wrenches in sizes ¼ inch to 1¼ inches; a full line of carbon and high-speed twist drills and reamers; a more complete line of screw and drop-forged wrenches than is shown by any other manufacturer, and many accessories. Send us your drawings and specifications for special drop forgings."

"Ball and Roller Bearings" is the title of an 18-page illustrated catalogue published by The Gwilliam Company, 253 West Fifty-eigth street, New York. Anyone interested in the subject should be sure to write for this catalogue, which will be sent to any of our readers upon request.

How to Stop Paying Toll for radio service is explained in a bulletin published by the Kilbourne & Clark Manufacturing Company, Seattle, Wash. "The Kilbourne & Clark plan of selling radio apparatus outright makes it possible for all users of radio equipment, large and small, on land and sea, to free themselves of the excessively expensive practice of having to pay toll for radio service. Toll costs for a comparatively short period will pay for a Kilbourne & Clark set; and once purchased the set is the property of purchaser to use as much or little as desired. That the Kilbourne & Clark plan is the economical and logical one is seen in the large number of Kilbourne & Clark sets which are being used by the different governments, large steamship lines and land stations. The plant behind Kilbourne & Clark apparatus is the largest in the world. The apparatus is so efficient that more than two thousand-mile service is common for the two kilowatt sets. If you are interested in obtaining efficient radio apparatus, and being able to purchase it outright, by all means learn what Kilbourne & Clark apparatus offers."



SCALE REMOVAL EASY

The antiquated time-consuming expensive method of removing scale with a hammer and chisel is unknown when boilers are treated with

DIXON'S PIONEER
BOILER GRAPHITE

It makes no difference whether the feed water is good or bad. Dixon's Boiler Graphite (fine flakes) acts upon the scale physically—not chemically—breaks up the cohesion between the particles of scale and their grip on the boiler tubes and sheets—in fact makes scale easy to remove.

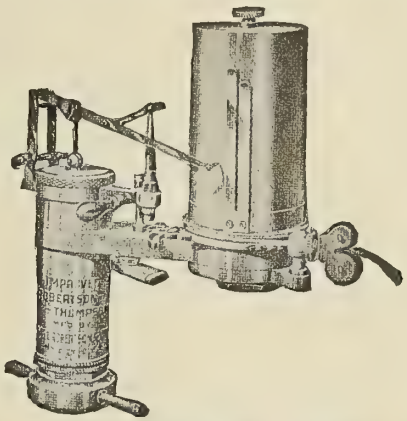
Do not confuse Dixon's Boiler Graphite with other boiler graphite. Write for booklet No. 75-T. It will show you how to lower your cleaning costs.

Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE COMPANY

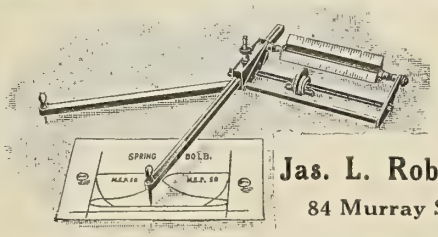
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You can't feel your Engine "Pulse" without a good Indicator—Here's the Robertson-Thompson and the Willis Planimeter. THE A. B. C. WAY OF REALLY KNOWING to the absolutely accurate and direct figuring of diagrams. THEN YOU KNOW.

The prices for these instruments are lower than you ever thought of. Don't you want to know them?



Jas. L. Robertson & Sons

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HELP AND SITUATION AND FOR SALE

☞ *No advertisement accepted unless cash accompanies the order.*

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Wanted—Experienced Marine Engine Draftsmen, *Fabricated Ship Corporation,* foot of Twelfth street, Milwaukee, Wis.

Wanted — First-class hull draftsmen. Write, stating experience and length of service with former employers. Address *Manitowoc Ship Building Company,* Manitowoc, Wis.

Practical Marine Foreman and Engineer wishes connection with repair shop. Would act as foreman and invest $3,000 to $5,000. Locate anywhere. References. Address *Box* 66, care of MARINE ENGINEERING.

Wanted—First-class Marine Engine Draftsmen of shipyard in New York district, building 9,000-ton ships. Answer in full regarding age, experience and salary expected. *Marine Engine Draftsmen,* care of MARINE ENGINEERING.

Shipyard Manager, now in charge of eight-berth yard, desires change; over twenty years' experience, both coasts and lakes, familiar with all classes of work, good organizer and handler of men, highest references. Address *XYZ,* care of MARINE ENGINEERING.

Mr. General Manager, I am open for connection as Works Manager or General Superintendent. Continuous marine experience of sixteen years with all classes of merchant vessels in executive capacity with foremost pre-war shipyards. Forceful executive, pace setter, agreeable personality, leader of men, full knowledge of proper operation of all departments to obtain highest efficiency and lowest production costs. Your reply will be accorded strict confidence and personal interview expected. Will consider any locality except Southern and Gulf district. Address *Box 7A,* care of MARINE ENGINEERING.

Marine Engineer desires shore position as shore engineer or repair superintendent for shipping company, or shipyard position requiring chief's ocean unlimited license; twenty years' experience, shipyards and at sea. Address *Box* 7000, care of MARINE ENGINEERING.

Wanted—Technical Graduate familiar with Marine Engineering specifications, first-class marine engine, electrical and pipe draftsmen. Permanent positions for right men in shipyard near New York City. Address *Graduate,* care of MARINE ENGINEERING.

For Sale — One 13-inch General Electric type P. C. thirteen, twenty-ampere, one hundred fifteen-volt direct-current searchlight, complete with rheostat, overhauled and in A-1 condition. Three 67-foot and three 75-foot cargo booms in good condition. Address *Freeport Sulphur Company,* Freeport, Tex.

Shipbuilder, with 18 years' experience in leading yards and New York harbor work, seeks responsible position as designer or naval architect, or would act as consulting engineer to parties contemplating extension of present fleet. Address *Designer,* care of MARINE ENGINEERING.

Marine Oil Engines for Sale—Four 100-horsepower Fairbanks-Morse new oil engines; four 350-horsepower Diesel engines; two 500-horsepower Diesel engines; one 25-horsepower Fairbanks-Morse type "Y" crude oil engine. *Inland Navigation Company, Inc.,* St. Louis, Mo.

Foreman Loftsman, desiring change, wishes to connect with shipyard on Atlantic coast. Fifteen years' experience in largest shipyards as loftsman and shipfitter, eighteen months as foreman loftsman. Can qualify as foreman of shipfitters and assemblers. Address *Box* 103, care of MARINE ENGINEERING.

High-Class Engine Designer Wanted, also draftsmen, tracers and designers for structural and mechanical work on boats, derricks, etc. Good salaries and permanent position to the right men. Address *Chief Engineer, The Dravo Contracting Company,* Engineering Works Department, Pittsburgh, Pa.

Shipbuilder open for suitable position. Last employed as assistant hull superintendent. Has also been foreman of mold loft, also foreman shipfitter. Thoroughly conversant with latest methods of fabrication and erection. Address *Box 4-K,* care of MARINE ENGINEERING.

Designing and Detail Draftsmen—For permanent positions with large manufacturing concern in New England. Men with electrical, steam engine, turbine or special machine experience. Apply, giving age, experience, education and salary expected by addressing *Chief Draftsman, Box No. 90-X,* care of MARINE ENGINEERING.

For Sale at a Bargain, six used marine projector searchlights, complete with dispersion lenses and rheostats; 220-volt D. C. Carlisle & Finch Company's make. Form 1-M, plain hand-controlled, 14 inches. Have been in use for one year. Good as new. Make us an offer. *American Rolling Mill Company,* Middletown, Ohio.

Wanted—Shipyard Executive. Duties, general supervision with exception of office routine. None considered who had not received a salary in excess of $4,000 a year prior to 1914. Reply with full record, giving details of education, shipyard experience, salary expected, etc. Address *Box* 419, care of MARINE ENGINEERING.

Wanted—Several experienced mechanical draftsmen; preferably men who have had thorough experience in the designing of marine Diesel or steam engines of large sizes. State age, experience and salary expected; permanent position. Address *Electric Boat Company,* Groton, Conn.

Engineer, 25, college graduate, eight years' experience with all kinds of mechanical and electrical machinery, desires position in city as operating or efficiency engineer. Wishes to specialize at evening session of university. During the war was chief engineer of 15,000-ton ship. Address *Box* 325, care of MARINE ENGINEERING.

Position Wanted—Young man, 27, graduate of leading technical university, naval architect and marine engineering, now employed as hull foreman and general inspector for large ship building company, desires connection with marine insurance and brokerage firm or consulting naval architects and marine engineers. Address *Box* 705, care of MARINE ENGINEERING.

Engineer, 25, Marine, with scientific education, B. Sc. (M. I. T.). Has had varied experience in construction and design of steel and concrete ships. Has served in capacity of Assistant Outside Superintendent in large Government Navy Yard. Last employed as Engineer in construction for well-known concrete shipyard. Open for engagement with either steel or concrete shipyard, presenting the right offer. Anyone looking for a "Live Wire," address *Engineer,* care of MARINE ENGINEERING.

Mr. Manufacturer of Marine Equipment and Appliances, do you require a District Manager or Sales Engineer? One who has a thorough knowledge of shipyard requirements, ship construction and operation; one who has a broad acquaintance among shipyards and steamship lines. Possesses good mixing qualities, good personality and sales qualities and experience of a character which will produce results. An untiring worker, master missionary and a closer. Your reply will be given strict confidence by the *"Salty Salesman,"* care of MARINE ENGINEERING.

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MARINE SALES MANAGER

Real position open with one of the oldest and best established concerns in the Marine Steam Engineering Field. Equipment saves fuel and labor, increases speed and steaming radius. In use on hundreds of vessels, including majority of new Emergency Fleet.

Qualifications: Actual experience in marine steam engineering from both operational and sales end. Must have and be able to maintain close affiliations with ship-owners, managers and fleet engineers. Able to take charge of all marine sales in the east with office and headquarters in New York. Liberal salary and bonus.

Address:

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Box 851 Detroit, Mich.

Draftsman Wanted:

To do tracing and copying. Must be a good letterer. State experience, salary expected, etc.

Tracer, care of Marine Engineering.

The

Shipbuilders' Hand Book

by Harrison S. Taft

Price 15/-

For sale by

BENN BROS., Ltd.

8 Bouverie Street, London, E. C. 4

FOR SALE

Triple Expansion Marine Engine 18″ x 32″ x 54″—42″ stroke. Has been in service fifteen lake seasons in a wooden steamer of 3000 tons capacity. Has been thoroughly overhauled and is in A-1 condition. Shipping weight approximately 70 tons.

Windlass, 8 x 10 of Providence manufacture, suitable for 1¾″ stud link chain. Arranged for capstan drive. In first class condition.

Both subject to inspection. Immediate delivery.

McDougall-Duluth Company

Duluth, Minn.

FOR SALE

To reduce our stock of surplus war materials we offer for immediate sale the following:

Clear and Common Oak, 1″ to 12″ thick; 12′ to 40′ long.

Clear White Pine, ½″ to 3″; 6′ to 16′ long.

Spruce, Cedar, Mahogany, Ash, Elm, Long Leaf Yellow Pine,
Hackmatack Knees, all sizes.

Brass and Iron Marine Hardware, Woodworking Machinery.

If interested, apply promptly to

THE MATTHEWS COMPANY

PORT CLINTON OHIO

"Dressing Tools With the Bradley" is the title of a circular issued by C. C. Bradley & Son, Inc., Syracuse, N. Y. "For dressing tools and repair work the Bradley hammer is indispensable. This perfectly controlled hammer may be used for a vast range of work. Continuous service required by the shipbuilding industry—constant pounding on resisting surfaces—has no effect on the Bradley. Rubber cushions at the rear of the helve absorbs shock and helps to prolong life and maintain accuracy. If you wish a hammer for continuous forging send for particulars to-day."

"The Solution of Your Flanging Problems" is the title of a booklet just published by the McCabe Manufacturing Company, Lawrence, Mass. "A two-man flanging gang with the McCabe pneumatic flanging machine will turn out twice the number of flanged parts per day that the old style hand flanging gang will do. The McCabe pneumatic flanging machine occupies small shop space, and absorbs all the tedious, back-breaking work of hand flanging. With this sturdy tool in your shop, you need have no thought of important work being held up on account of workmen laying off. Sheet metal up to and including ½ inch in thickness is flanged cold with the McCabe. This eliminates lost time waiting for 'heats' and insures steady production. The McCabe is a self-contained unit, and can be moved from one job to another or from one part of the shop to another part."

Repair Part Insurance is the subject of a circular published by the Duntley-Dayton Company, Westminster building, Chicago, Ill. "Duntley-Dayton tools are designed to keep up the production and keep down the repair bills. He may have been a pessimist who coined the phrase, 'It isn't the first cost; it's the upkeep,' but he was an optimist who conceived the idea of so simplifying the construction of a pneumatic tool that its cost of maintenance would be reasonable. Simplicity of construction and durability are outstanding features to such an extent that investment in Duntley-Dayton pneumatic tools is a form of repair part insurance that goes with the purchase. You are invited to send for Bulletin No. 101, telling all about Duntley-Dayton hammers and other pneumatic tool accessories. You are also invited to send for Bulletin No. 102, which gives the prices of the repair parts—an important consideration in the selection of pneumatic tools. There is a chapter on the 'Care of Pneumatic Hammers' in this bulletin which is of interest to the man who pays the repair bills as well as the operator himself. You are also invited to send for Folder No. 104, entitled 'Hoseology'—a treatise on hose, hose couplings and hose clamp tools. And you are invited to send us your inquiries for pneumatic or electric tools of any description, and rivet sets, chisel blanks, grease and oil and other accessories."

"Little David" Air Tools are described and illustrated in Catalogue 8000, issued by the Ingersoll-Rand Company, 11 Broadway, New York. "The design is the most advanced of any gun made. The materials used are the best that can be obtained, carefully treated. The work produced by it cannot be bettered. It needs less attention from the repairman. Safety spring rivet set retainer an exclusive feature also. We make all other air tools."

Rich Tools are described and illustrated in a circular published by the Rich Tool Company, Railway Exchange, Chicago, Ill. "Locomotive, automobile, aeroplane, gun and machine parts, subject to maximum shocks of great frequency or torsional strains are first forged. Why? Because forging increases their physical properties, rearranges the structure to withstand stresses in any desired direction, and gives each portion the required amount of working. At the proper temperature the flutes of Rich tools are first forged and twisted. The result is a blank thoroughly uniform in every part and of superior physical properties to the bar from which it was made. Not welded, brazed or built up—made in one piece of the most suitable and best high-speed steel of the proper composition—every operation and process is conducted with care and judgment. It is unnecessary to tell you that this drill will produce maximum service—it is built for it."

Electric Arc Welding Equipments are the subject of several bulletins issued by the Westinghouse Electric & Welding Company, East Pittsburgh, Pa. "The three prime requisites of electric arc welding equipment are: 1. Sufficient potential capacity to sustain the arc when lengthened, for you have to overcome irregularities in the materials being welded, which causes variations in the resistance of the circuit; 2, in starting the arc the current should not shoot up too high, but should be above the normal welding current in order to give the necessary heat at the start; 3, constant heat at the arc. This requires variable voltage at the arc to maintain constant current, as the heat of the arc depends on the current flowing. The reason that variable voltage is required to maintain constant current is due to variation in the resistance of the arc path or circuit, due to the following: (a) Foreign matter, such as scale, rust, etc., in the path of the arc; (b) variation in the length of the arc, caused by the molten metal traveling from the electrode to the weld; (c) unsteadiness of the operator's hand, and (d) unevenness of the surface over which the welding arc is directed. Westinghouse electric arc welding equipments meet these requirements. Built in sizes from 150-ampere to 1,000-ampere capacity. 1. Single operator equipment—stationary type. 2. Single operator equipment—portable type. 3. Multiple operator equipment. Built for all commercial circuits, either alternating or direct current."

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INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
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NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
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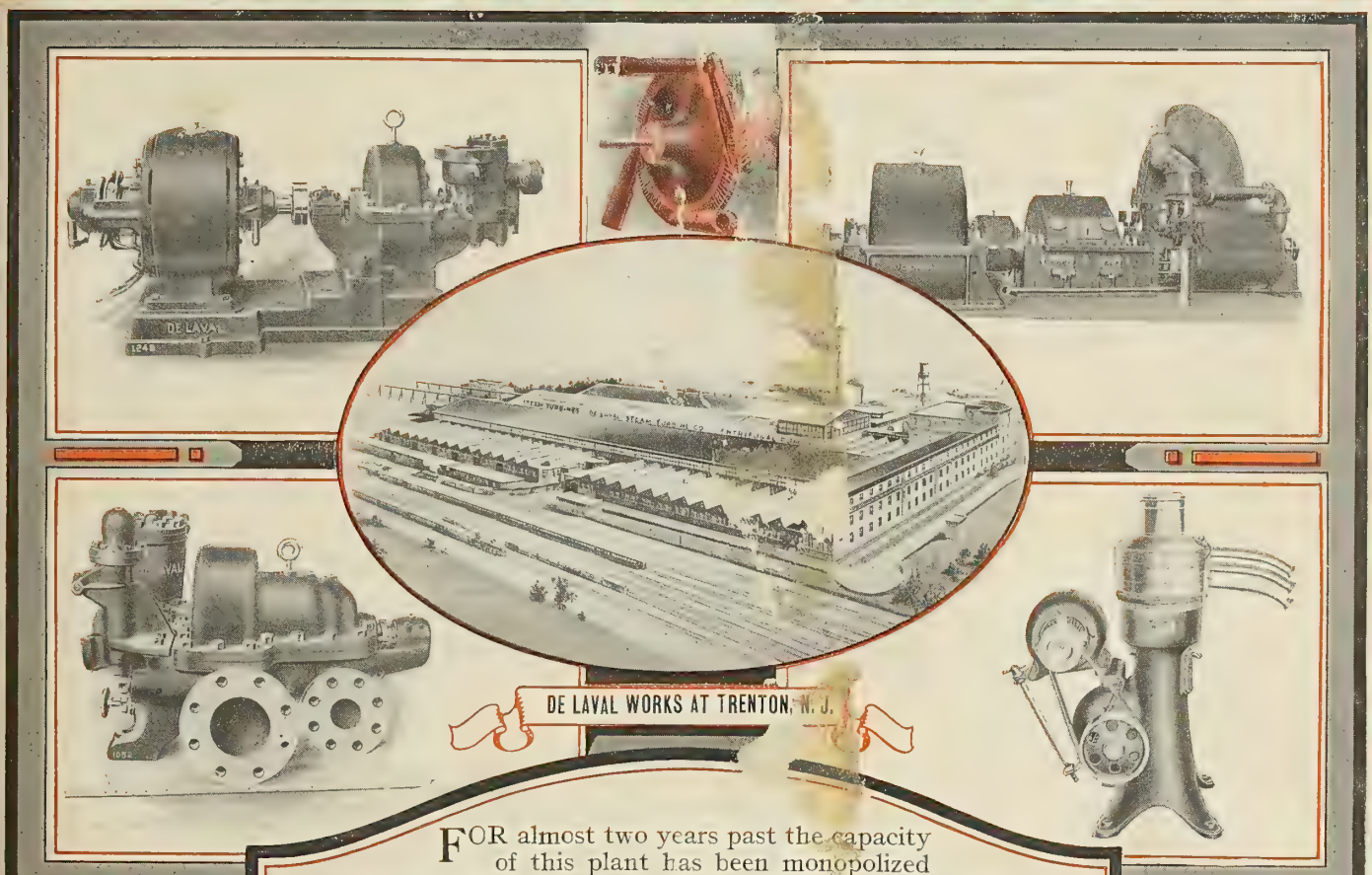
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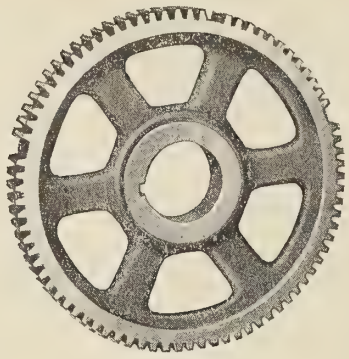
FOR almost two years past the capacity of this plant has been monopolized almost exclusively by the United States government, for the production of geared turbine propelling units for the Navy and the Emergency Fleet. This work is now practically completed, and we are in a position to render good service to domestic customers and to make prompt shipment.

This high-grade, finely equipped and well organized plant is at your service for supplying:

Steam Turbines,
Double-helical Speed-reducing gears,
Centrifugal Pumps,
Turbo-Generators,
Centrifugal Blowers, and
Special centrifugal Machinery.

The record of De Laval geared marine turbines is testimony to the ability of our Engineering Department and to the good quality and accuracy of our shop work. State what you are interested in and appropriate literature will be sent.

DE LAVAL STEAM TURBINE COMPANY
400 NOTTINGHAM WAY TRENTON, N. J.



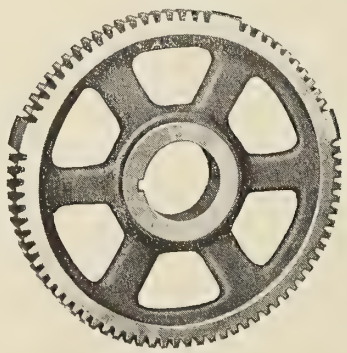
PAINLESS DENTISTRY *for* GEARS

YOU wouldn't discharge the foreman if he lost a molar. Why scrap a gear just because of a few broken teeth? Why not fill in with new metal—as shown here—and recut? This is only one of a thousand ways to oxweld and reduce costs. Ask us to send you the Bulletin that tells about the advantages of oxwelding in your industry.

Oxweld Acetylene Company

NEWARK, N. J. CHICAGO LOS ANGELES

World's Largest Maker of Equipment for Oxwelding and Cutting Metals



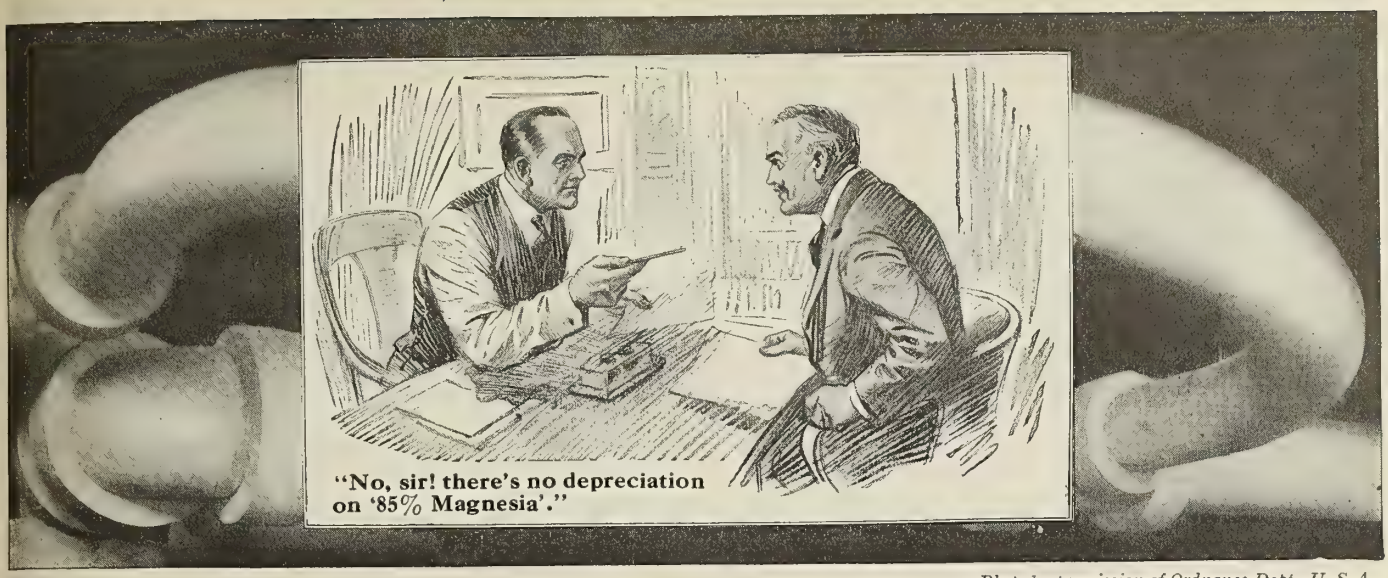


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That's what the chief engineer told his president—

They were figuring on Depreciation of Equipment.

The engineer was saying, "Some fellow the other day was knocking our '85% Magnesia' pipe-coverings. So I wrote to W. A. Macan, Chairman of the Magnesia Association. He has been in the pipe-covering business for over 30 years and I wanted his straight experience. He says *there's no such thing as '85% Magnesia' depreciation.* Here's part of his letter:"

Time-proof—Usage-proof—Not Fool-proof

You can soak "85% Magnesia"—and it dries out as good as ever. You can hold "85% Magnesia" on a shovel over a fire till the shovel gets red-hot—and it isn't hurt. You can give "85% Magnesia" all the tremendous vibration of a locomotive—and it does not disintegrate.

But it isn't a concrete sidewalk for workmen to tramp on; nor a stone wall to bump with heavy ladders. Nobody but a fool would subject any cellular insulation to such ill-usage.

Indeed, if any pipe-covering does not crumble under heavy walking or heavy blows, it is a certain sign that it is lacking in the dead-air spaces which give it its real insulation value.

We invite specific questions on the durability as well as the efficiency of "85% Magnesia." The Engineers of the members of this Association, as well as the experts of the Mellon Institute who have been specially investigating pipe-coverings for three years, are at your service through our Committee. Send for our literature. Also for Specifications for the proper application of "85% Magnesia" compiled and endorsed by the Mellon Institute of Industrial Research of Pittsburgh University, which are furnished to Engineers and Architects on request.



MAGNESIA ASSOCIATION *of* AMERICA
721 Bulletin Building, Philadelphia, Penna.

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From a Veteran's Experience in "85% Magnesia"

"While it is a common practice to charge up each year a percentage of the cost of a plant for depreciation, in the case of "85% Magnesia" this is not necessary.

"Thus in the Niagara Power Station, '85% Magnesia' covering has been in service nearly twenty years; when recently a section and block of this '85% Magnesia' were analyzed and tested, it showed a depreciation after all those years of approximately 3%—so small that it could hardly be figured.

"Again, the Mellon Institute of Industrial Research of Pittsburgh University has on file many letters from Operating Engineers who have had '85% Magnesia' in service for ten years to twenty-five years stating that those coverings are as efficient today as when first placed in service.

"As long ago as 1888 Mr. J. J. DeKinder was a Consulting Engineer in Philadelphia, having the Pennsylvania Railroad among his numerous clients. A short time ago he wrote me:—

> "'I have specified '85% Magnesia' covering for a great many years, in fact, during all my active practice. I have used it under all procurable temperatures, and under all conditions that stationary and locomotive service furnish, and can recall *no time* in which it failed to render efficient service.'

"It may become soaking wet through steam-leaks, floods, sinking of a vessel, or any similar cause, not only once but several times, and when steam is turned on the boilers again, it dries out without shrinking or warping, and continues saving heat units just the same as it did before.

"I challenge anyone to give good evidence of any case where '85% Magnesia' properly applied and properly treated has failed to give maximum and satisfactory service through any inherent defect."

WM. A. MACAN
Chairman Magnesia Association of America

TRADE PUBLICATIONS

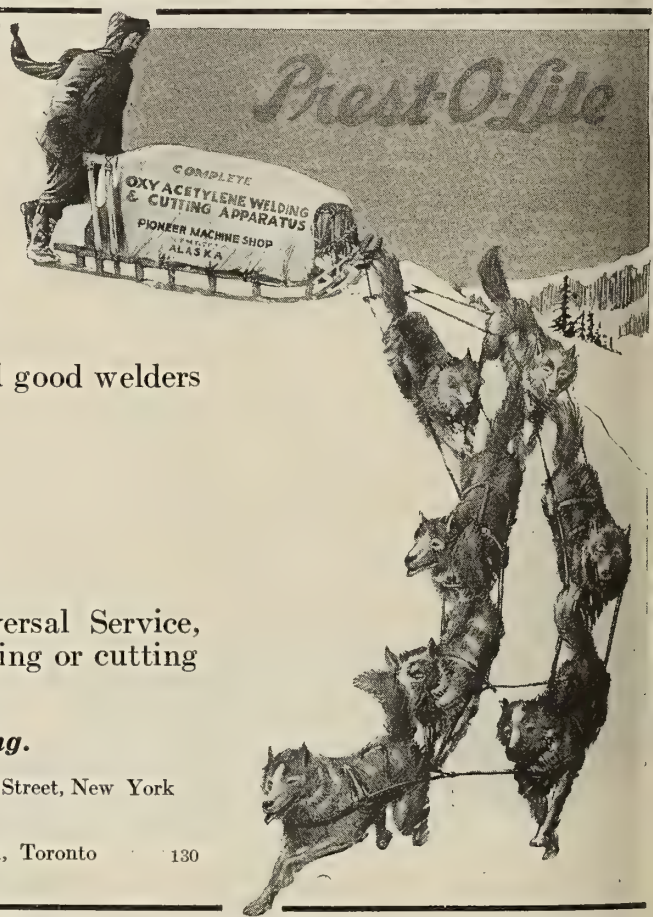
The Wayne Paint Oil Storage System for the storage and distribution of linseed oil and turbine, oil paints, etc., is described in Bulletin 70 published by the Wayne Oil Tank & Pump Company, 589 Canal street, Fort Wayne, Ind. "Paint oils, varnishes, etc., must be kept in evaporation-proof containers in order to maintain their original consistency and prevent waste. Storing these commodities in wooden barrels, faucet tanks or iron drums allows their evaporation, contamination with dirt and dust, waste and overmeasure, and in the case of linseeds, varnishes and paints allows the formation of 'foots and fats,' which render these liquids thick and unfit for use. The Wayne system of battery storage preserves these liquids in their original state, prevents evaporation and loss through over-measure, enables the keeping of a correct record of the amount received and dispensed. The equipment is practically fireproof. Tanks made in capacities of two barrels and up in battery form. Can be added to as needed, height and length from front to back of the entire battery remaining uniform, and width across front varying according to capacity, economizing floor space to the greatest possible degree."

The Thor "Perfect" Hose Coupling is described in a folder just published by the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill. The new "Thor" Perfect Hose Coupling "is disconnected instantly by a straight pull on the knurled sliding sleeves. It is not even necessary to twist, as the bevel jaws separate as soon as the locking shoulder moves back. The bevel jaws and locking shoulders are heavy, with large bearing surfaces, and cannot bend, break, jar or work loose. Heavy, unbreakable sliding sleeves insure extreme durability. The operating spring is large and durable, but can be easily replaced, if necessary, by removing washer. A shoulder is provided on each hose end, so the new Thor hose clamp can be used. The L-shaped gasket is held in place by the air pressure when coupling is connected. It cannot be blown out when coupling is disconnected because of the bevel face on the gasket and protecting shoulder in the coupling. Gaskets are interchangeable in ⅜-inch, ½-inch and ¾-inch sizes. Gaskets in the 1-inch and 1¼-inch sizes are interchangeable."

Electric Air Compressors, Portable Electric Drills and Electric Valve Grinders are the subject of an illustrated catalogue just published by the Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore, Md. The company's portable electric drills are described as follows: "These are high-class machine tools in every sense of the word. They are designed and constructed for drilling in metal or wood and are husky and serviceable throughout, having many exclusive features to recommend them especially. They are the result of years of experience in electric drill manufacture, and are thoroughbreds in performance as well as in appearance. The 'Pistol Grip and Trigger Switch,' which is patented, enables the operator to control the tool like an automatic pistol. This increases his efficiency and at the same time makes his work easier, as he can 'forget' the control, which is practically automatic, and devote his entire attention to guiding the tool. This reduces drill bit breakages, as, if the drill bit catches on a burr, or when it breaks through the work, the operator naturally tightens his grip, instinctively pulling the trigger and stopping the drill. There is no danger of the drill sagging on the bit when the switch is being operated, as the mechanic does not have to change the position of his hands in the slightest degree. This also lessens the risk of inaccurate centering in starting."

Electrical Goods are described and illustrated in a sectional catalogue just issued by Edwards & Company, 140th and Exterior streets, New York. This company makes a specialty of marine electrical work, and anyone interested in the subject should send for a copy of this catalogue, which describes marine signals, annunciators, watchmen's clocks, fire alarm apparatus, push buttons, door openers, bells of all kinds, etc.

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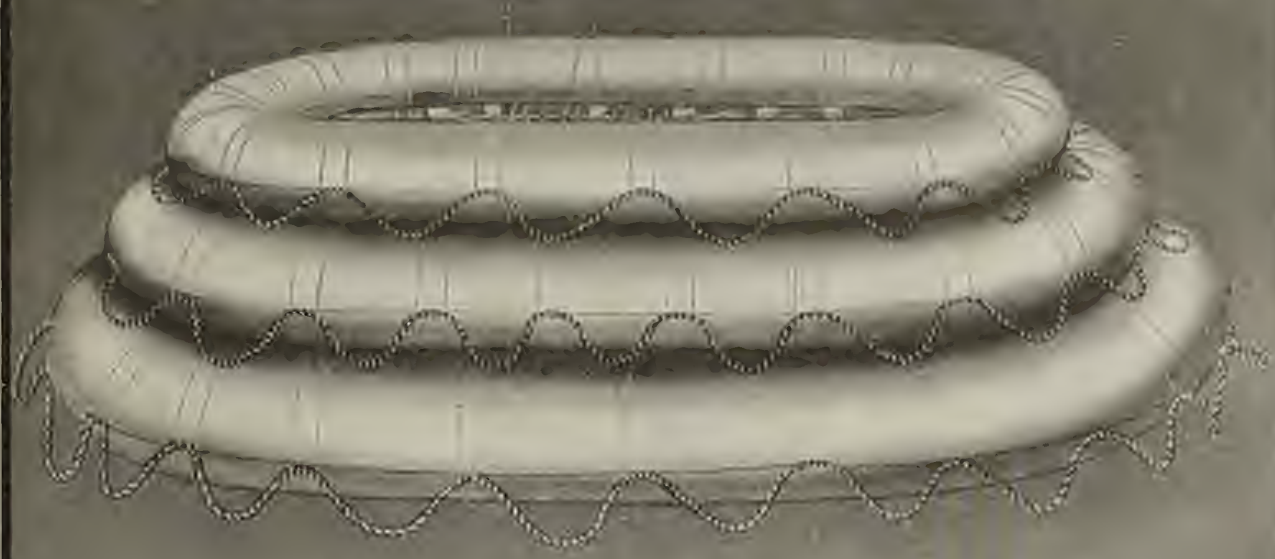
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Welin Marine Dept. **50 E. 42nd Street, New York**

London House: 5 Lloyds Avenue, London. E. C

"Spraco" Air Washing and Cooling Equipment for steam turbine generators and other electrical machinery is described by the Spray Engineering Company, 93 Federal street, Boston, Mass., in Bulletin 257. "With the advent of the modern, horizontal, high-speed generators, the matter of the proper ventilation of same has become of great importance. The heat losses per unit of surface or of active weight are relatively much larger than in the older machines, making forced ventilation essential. The amount of air required varies with the size and type of the generator, some of the later and larger models using less air per K. V. A. on account of their higher efficiency. The necessity of properly conditioning the ventilating air is now recognized by engineers as secondary only in importance to the securing of an ample supply of air. The air should be cleansed of all dirt, cooled and humidified. To accomplish this in an efficient manner, a water-spray type of air washer and cooler has been found to be the best device. The Spray Engineering Company, pioneers in the design and manufacture of washers essentially for power-plant service, has developed and perfected the well-known Spraco air washing and cooling equipments, used almost universally in this country and abroad."

Ross Condensing Equipment, with Croll-Reynolds Evactor Air Pump, is the subject of Catalogue "C," just published by the Ross Heater & Manufacturing Company, Buffalo, N. Y. Many advantages are claimed, besides which "there are no valves or pistons to require constant attention. There are no moving parts. There is no noise, pounding or hammering. The Evactor requires little attention and no repairs, as compared to the reciprocating dry air pump or the hydraulic air pump, which were formerly in vogue before our evactors were perfected. No power plant needs to burden itself with the old-style vacuum pump—so expensive in its first cost—so sure to cause endless repairs and attention—so certain to show rapid dropping-off in efficiency."

Badger Self Equalizing Expansion Joints are described in Catalogue 18, published by E. B. Badger & Sons Company, 63 Pitt street, Boston, Mass. "Self-equalizing expansion joints distribute stress uniformly. This is an advantage that cannot be emphasized too strongly. The equalizing rings and lip on flanges limit the amount of compression on each corrugation; (first) insuring undue strain on any part; (second) high factor of safety, from standpoint of strength. Corrugations on joints 6 inches and over, 2¼ inches deep; corrugations on joints under 6 inches, 1⅛ inches deep. There is no cracking, jamming or pipe distortion, because of the scientific design. There is no stuffing box or sliding member. Badger joints are dependable under all pressures."

"Making Air Work" is the title of a booklet issued by the B. F. Goodrich Rubber Company, Akron, Ohio. "Your air drills and hammers are the hardest working agents in the shipyard to-day. And the air that makes them work costs nothing, yet without compressed air and the hose that conveys it modern shipbuilding could not be. Your pneumatic hose must be strong, light, flexible, easily portable, kink-free and able to stand the worst abuse of men and machines. Your hose should be Goodrich hose, which possesses all these merits and more. Goodrich hose helped make shipbuilding records on the East and West coast last year. Write for the facts."

Texaco Bunker Oil and Texaco Diesel Engine Fuel are described by the Texas Company, 17 Battery Place, New York, in a booklet just published. The foreword reads as follows: "When the allied navies cried for oil—and more oil—the Texas Company realized its responsibilities fully and extended its shipping and bunkering facilities as rapidly as the restricted construction situation would permit. Now that building restrictions have been removed, we are rushing to completion more stations, so that the merchant marine of the world may now call at practically every port on the Atlantic and Gulf coasts and secure Texaco Marine Fuel Oils and Texaco Marine Lubricating Oils. This brief pamphlet tells you what they are and where to get them."

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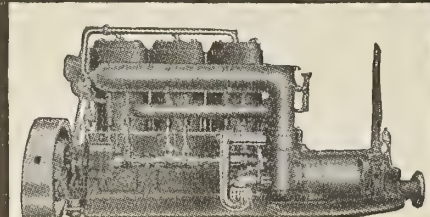
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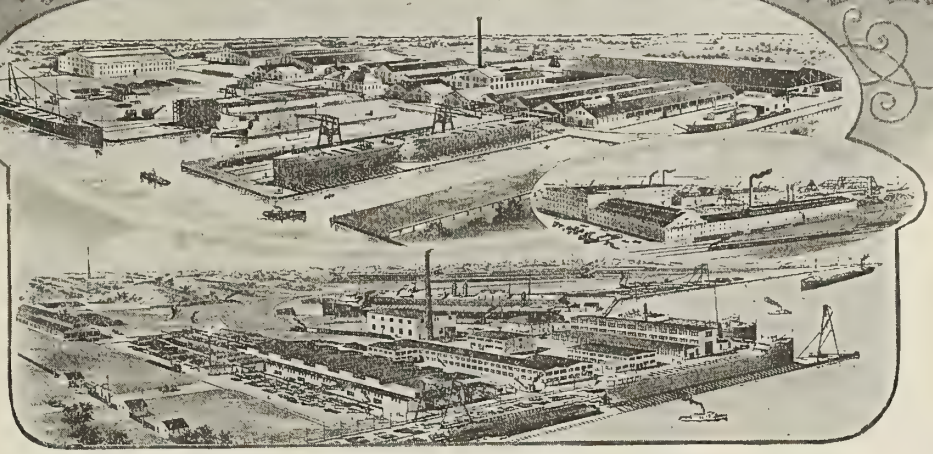
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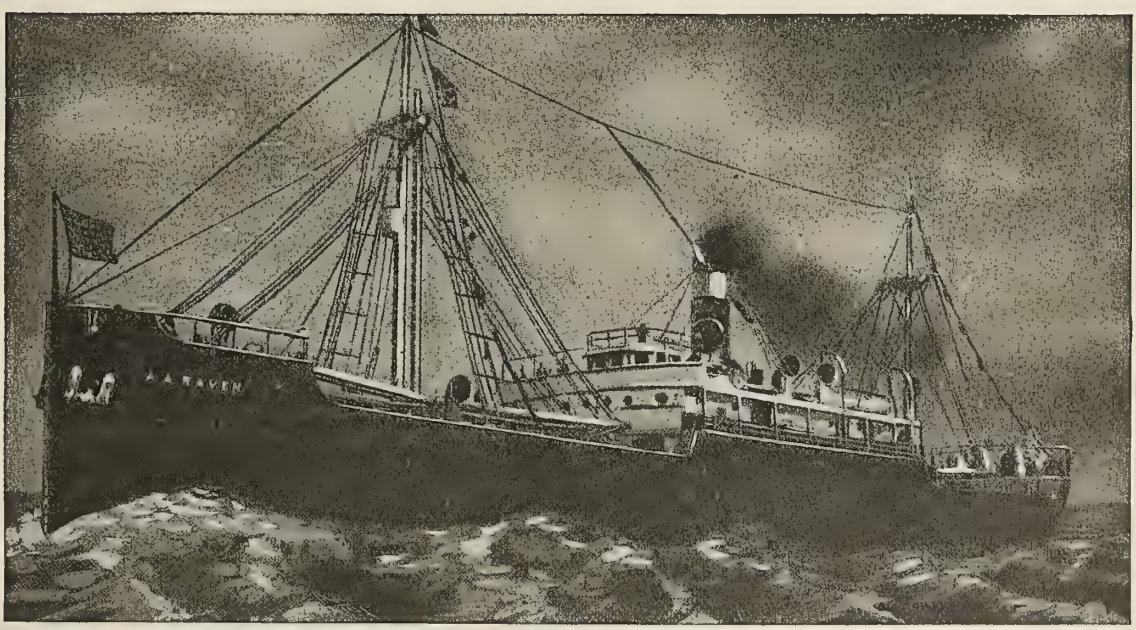
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Why the Terry Leads in the Small Turbine Field is the subject of a bulletin published by the Terry Steam Turbine Company, Hartford, Conn. "It's the Terry feature by which the steam is used several times in a single row of internal buckets instead of a number of bucket rows or wheels. This invention, by returning the steam to the wheel again and again until its capacity for work is completely exhausted, gives high economy at low as well as high rotative speeds. A patented 'efficiency chamber' insures that none of the steam will pass to the exhaust before its energy is completely spent. The power-producing action of the steam in the wheel buckets takes place entirely on the curved surfaces at the back of the bucket. As the only function of the blades is to split the steam jet, close blade clearance is not necessary, and wear of blades is of little consequence. With this construction, turbines will maintain their original efficiency for years. The Terry wheel, made from solid steel, with buckets milled in the edge, is as simple and trouble-proof as a wheel could be. The reduction in rim weight and decrease in blade stresses incidental to the removal of useless metal at the center of the blade permit safe operation at high speeds, with resulting high efficiency. The use of the single wheel permits short shaft span, so that there is no danger of the wheel reaching the dangerous "critical speed" in operation. The Terry wheel as now built cannot burst and injure the operators."

Machine Tool Motors are the subject of Bulletin 4102, published by the General Electric Company, Schenectady, N. Y. "Adjustable speed machine tool motors should require no complicated protective or control devices; must show no destructive sparking throughout a wide range of speeds under sudden and extreme peak loads or dynamic braking, must show stable operation at any speeds desired throughout a wide range and easily withstand sudden strengthening of the field while operating at weakened field. These requirements have been met for several years by RF motors under the severe conditions imposed by the world war upon American industry. The rigid, get-at-able, oversize construction of these motors, their dependable oiling devices, removable shafts and many other mechanical features contributed to assure a remarkably dependable operation. Our Bulletin No. 4102, 'RF Adjustable Speed Motors,' will give you fullest details. Our specialists will be pleased to send you full information on these motors."

The New Flexible Marconi Plan is the subject of a circular published by the Marconi Wireless Telegraph Company of America, Woolworth building, New York. "Ship owners whose Marconi-equipped vessels are returned by the Government can now shift the burden of maintenance and operation to our experienced shoulders—they can contract with us to operate their wireless equipment. This is made possible by the flexibility of the new Marconi plan—a three-way plan, which includes rental contract with service, or sale outright, or sale with service. Under any of these arrangements the ship owner secures Marconi apparatus, and where service is contracted for he gets the complete co-operation of the entire Marconi organization, world-wide in its scope. This service—already in operation—is available now. Our nearest office will prove to you how it saves money, time and endless trouble."

"Little Giant" Air Drills are described and illustrated in Bulletin 127, published by the Chicago Pneumatic Tool Company, 1044 Fisher building, Chicago, Ill. "Bethlehem steel is one of hundreds of users the world over who are minimizing drilling, reaming and tapping costs with Little Giant portable air drills. A shop equipped with Little Giant ball bearing air drills is a shop protected from experiment and defect in portable drill design. For twenty-five years the Chicago Pneumatic Tool Company has been known as the pioneer in pneumatic tool progress. In the Little Giant line of portable air drills are embodied the results of a world-wide experience in meeting shop requirements. Little Giant air drills have never been surpassed in work accomplished, economy of air consumption and durability of parts. They are made in a wide variety of sizes and styles to meet every need of drilling, boring, reaming, tapping and screw-setting operations."

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Chicago Minneapolis Toledo Newark Newport News Detroit Atlanta New Orleans Sabine

The Coppus Centrifugal Turbo Boiler Feed Pump is described in a catalogue just published by the Coppus Engineering & Equipment Company, Bristol, Mass. "In our Type CCC turbo boiler feed pump the pump is designed specifically for the purpose of forcing hot water into a boiler against steam pressure, and the steam turbine is built to drive this pump. We do not use an ordinary high-pressure pump which can be employed for any other purpose, and therefore we are in a position to choose exactly the proper materials with regard to the high temperature of the feed water and also to use the most rugged construction on account of the severe uses to which the boiler feed pump is subject. The same holds true for the steam turbine. After once deciding upon the most efficient design with regard to steam consumption our only purpose was to develop a steam turbine in which self-contained construction and absolute reliability of operation were the main characteristics."

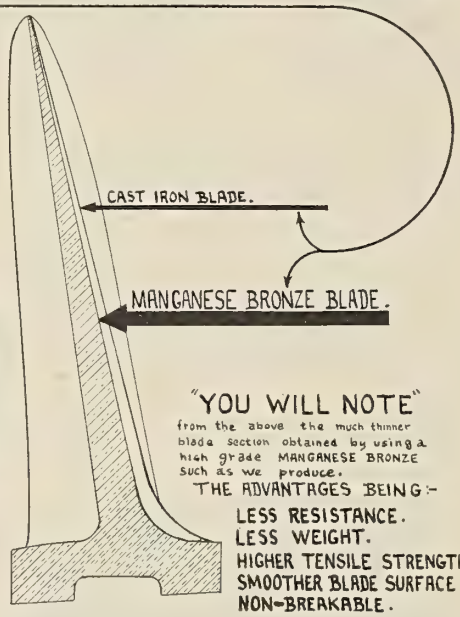
The P & W Turntable Lathe is described in a special catalogue just published by the Pratt & Whitney Company, 111 Broadway, New York. "The cross-feeding turntable slide is one secret of its success. In the handling of castings and forgings, this distinctive feature—the cross-feeding turntable slide with transverse stops—lends itself to the unlimited requirements of boring, facing and turning operations with the simplest tool equipment. Cross-feed in either direction is provided by hand or by six power feeds. Eight cross-slide stops can be adjusted to any desired position or combination. A micrometer dial attached to cross-feed hand wheel assures accurate traversing of cross-slide, and allows of setting the stops in desired relation one to the other, with accuracy and dispatch. The P & W 2½ by 26-inch Turntable Lathe has other distinctive advantages fully described in special catalogue. If you are interested in high production manufacture of duplicate parts write us to send you a copy."

Timed Lubrication is the subject of Engineering Bulletin S-60, published by the Richardson-Phenix Company, 120 Reservoir avenue, Milwaukee, Wis. "Not the quantity but the method of application determines the efficiency of lubrication of heavy oil marine engines. Timed lubrication—a drop of oil at each piston stroke, at the exact time and place where it is least affected by the heat of explosion—can be obtained only by using the Richardson Model 'M' sight feed oil pump. Nothing like this feature of timed lubrication can be obtained from any other lubricator than the Model 'M.' And timed lubrication is absolutely necessary for the efficient lubrication of heavy oil engines. The successful operation of a heavy oil-burning engine depends to a large extent on efficient lubrication. The Richardson Model 'M' and timed lubrication are worth your immediate investigation."

Punching and Shearing Machinery is described by the Hilles & Jones Company, Wilmington, Del., in a catalogue just issued. "Carefully worked out designs and with sufficient reserve capacity providing for an ample margin of safety, make sure of our product meeting all requirements. We make machine tools for working plates, bars and structural shapes; rotary bevel shears; plate bending rolls; plate straightening rolls; sheet levelers; flanging clamps; plate scarfers; beam copers; angle planers; plate planers; joggling machines; angle bevelers; rail straighteners."

"Why Parkesburg Charcoal Iron Boiler Tubes?" This question is answered as follows in a bulletin issued by the Parkesburg Iron Company, Parkesburg, Pa.: "A cold blast of air directed on a hearth charged with charcoal and iron ore produced the first iron. This iron was practically pure. The same process, although the charge has varied, is followed to-day by the Parkesburg Iron Company. The result is the same high-grade iron as of old. For boiler tubes this iron is ideal. It is fibrous, will not crystallize under shock or vibration, is ductile, can be easily and securely beaded, requires little calking and is pre-eminently weldable. Charcoal iron is non-corrosive and resists pitting. Boiler tubes of charcoal iron are more dependable and durable than steel, while the ultimate cost is much less."

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ESTABLISHED 1848

CHICAGO: Mineral Point Zinc Company, 1111 Marquette Building

PITTSBURGH: The New Jersey Zinc Co. (of Pa.), 1439 Oliver Building

The "Gaskette" Roll, made by the General Asbestos & Rubber Company, Charleston, S. C., is the subject of an illustrated circular the company has just published. "Don't wait till you need gasket material in a hurry—don't risk holding up a mighty important repair job while you send out and get a cut-piece of sheet packing. Prepare now—stock Garco Gaskette Roll to-day. Never before have you been able to buy high-grade, wire-inserted asbestos sheet packing in convenient, ready-to-use form like this. Never before have you been able to get it, cut 10 inches wide by 40 inches long—ready for the dozens of jobs where this size just fills the bill. Now you can keep in stock just the quantity you need—know that it is fully protected from dust and dirt—know that you are prepared for every emergency. Garco Gaskette Roll is the newest, biggest item in the complete line of highest quality Garco asbestos products. It is made of high-grade, long-fiber asbestos, thoroughly reinforced by an interwoven network of strong, fine wire. It is treated with Garco Special Waterproofing Compound—finished red on one side, graphite the other. Gaskets made from Gaskette Roll are guaranteed for the highest pressure or temperature ever met in steam or gas engine service. Make up your mind now to stock Garco Gaskette Roll. Ask your jobber for prices or write us direct for full information. The same high-grade Garco Sheet Packing also sold under Garco-bestos Brand in full rolls of 250 pounds and half rolls of 125 pounds, 40 inches wide, all standard thickness."

Drop-Forged Machinists' Tools are described in a booklet just published by J. H. Williams & Company, 63 Richards street, Brooklyn, N. Y. This company's "Agrippa" tool holders are described as follows in the catalogue: "Unusual precautions have accompanied the development of this line of holders. Every detail has been tested and given closest possible attention. Materials best adapted to each of its parts have had every consideration and variety of test. The design, with the thought of its fullest utility and non-obstructive character, has had abundant and purposeful care. The holders or shanks, all drop-forged from a strong, tough grade of carefully selected steel, are submitted to a special heat treatment or refining process, after forging, which develops resistance to all wear and the great strength necessary to overcome the pushing thrust imposed upon the cutters. The cutter-holding channel provides an unusually strong seat for cutter and great resisting qualities for the work imposed upon this portion of holder—a fundamental requirement in tool-holder efficiency."

Sperry Service is the subject of a bulletin published by the Sperry Gyroscope Company, Brooklyn, New York. "You never let go your anchor far from Sperry Service. Offices are maintained in New York, Cleveland, London, Tokio, Paris, San Francisco, Milan, Copenhagen, Stockholm, Boston and Yokohama. It is always possible to arrange by wireless for a Sperry engineer to inspect or adjust your gyro-compass. So perfect is the Sperry service organization that it is as easy to have your gyro-compass cared for as to obtain the help of a magnetic compass adjuster. For the first year after the installation of the gyro-compass Sperry service is free. After that the cost is nominal. There is but little need for any service on the gyro-compass other than occasional lubrication or inspection by your ship's electrician."

Economy Tiering Machines and Barrell Storage Racks are described in a bulletin published by the Economy Engineering Company, Chicago, Ill. "There is hardly an industry that does not have, in some way or other, an urgent need for the Economy System of storage and handling of heavy, bulky packages. The accompanying pictures visualize the application of this system to several different lines of business. The Texas Company has told the whole story of the Economy System in a few words, as follows: 'The Economy System has practically doubled our warehouse capacity, and the arrangement is such that every barrel may be easily reached. We are also handling our warehouse with the minimum amount of labor.'"

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- Steam Turbines
- Internal Combustion Engines
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  - Heavy oil (Diesel)
  - Producer Gas

AUXILIARIES
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- Feed Heaters
- Filters
- Evaporators
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- Separators
- Blowers
- Pneumercators
- Time Firing Regulators
- Steam Traps
- Ash Ejectors, etc.

- Valves and Valve Gears
- Refrigeration
- Electricity
- Propulsion and Powering
- Operation, Management and Repairs
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The sixth edition has been enlarged by the addition of a chapter on miscellaneous machinery covering steering engines, capstans, windlasses, boat cranes, anchor engines, ash hoisting engines, towing engines, ventilating, heating and cooling apparatus, sirens and whistles, fire extinguishing and fumigating apparatus, reducing valves and regulating valves. The book now covers the latest practice in both propelling machinery with their auxiliaries and the deck machinery used in the handling of a vessel and her cargo.

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- Capstans
- Windlasses
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- Sirens and Whistles
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1067 pages. The book is illustrated with 550 diagrams and cuts, showing the most approved practice in the different branches of the subject. The text is in such plain, simple language that any man with an ordinary education can easily understand it.

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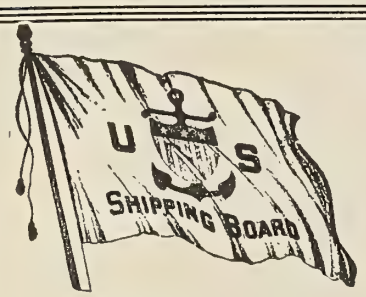
MARINE ENGINEERING, 6 EAST 39th STREET NEW YORK CITY

The Advantage of the "Cleco" Pressure-Seated Air Valve are set forth in Bulletin No. 41, just issued by the Cleveland Pneumatic Tool Company, Cleveland, Ohio. "Has but three parts —body, valve plug and handle. No packing required—has air-seated valve plug. Unrestricted inlet opening—equals the area of outlet. Has no angle turns in air channel as in other types. Air pressure is always on large end of valve plug, holding same firmly on valve seat. Provided with waste arrangement when valve is closed. Made in following sizes: ⅜-inch, ½-inch, ¾-inch, 1¼-inch, 1½-inch and 2-inch outlets. Inlets one pipe size larger. Standard pipe threads; valve shown in cut at left has female Bowes coupling outlet, and connects with sizes ¼ to ¾, inclusive. The Y-fittings illustrated permit the use of two air tools on one main line hose; these fittings are convenient for the boiler maker when working inside of the boiler, as the operator can turn on or shut off the air without leaving his work, which is a great convenience. Style D. Y. F. has two valves, and permits of independent air control, allowing two operators to run tools at one time. Style D. Y. M. has one valve control for one operator, using the two air tools alternately. Both fittings have Bowes coupling inlets and outlets, and connect with couplings sizes ¼ inch to ¾ inch, inclusive."

The Oxy-Carbo-Hydrogen process of cutting steel and wrought iron is described in an illustrated catalogue of 26 pages, published by the Carbo-Hydrogen Company of America, Benedum Trees building, Pittsburgh, Pa. "Recognizing the need of service to customers and instructions in the proper use of the Oxy-Carbo-Hydrogen process in the cutting of steel and wrought iron, the Carbo-Hydrogen Company from the beginning has maintained an efficient staff of demonstrators for this work. Our service men made regular trips throughout the different territories to see that all Carbo apparatus is properly operated, and make minor repairs that may be necessary from time to time on this apparatus. We are always glad to cooperate with our customers in devising new ideas for the use of the Carbo-Hydogen process and to help them in reducing their costs of operation."

"Have You Considered the Importance of Good Riveting?" Catalogue 8000, published by the Ingersoll-Rand Company, 11 Broadway, New York, gives much information on the subject of good riveting. "First, what is meant by good riveting? Good riveting means that the holes are well filled with metal, that the heads are of the proper shape and centered over the shank, and that the rivet should be tight. The matter of centering the heads depends upon the way the workman holds the hammer; the axis of the hammer should coincide with that of the rivet, as the workman is holding in the illustration. A well-filled hole and tight joint, however, are obtained by the use of the proper hammer. 'Little David' riveting hammers are made in a number of sizes and styles. They are guaranteed to give a well-filled hole and tight joint, and are particularly suited to the exacting conditions of boiler making. A majority of the largest manufacturers of Scotch marine boilers have adopted 'Little David' hammers as being the most efficient for this kind of work. You will find them most efficient for your work, however difficult. Let us send you more information regarding our pneumatic tools. Ask for Catalogue 8000."

Shipyard Air Tool Service is the subject of Catalogue 8000, published by the Ingersoll-Rand Company, 111 Broadway, New York. "Shipyard air tool service has its beginning in supplying you with air tools of the highest quality and of just the right size. Little David tools are sturdy, powerful and simple in design, easy to operate and maintain. They are built in a wide range of sizes and styles to meet your requirements in the most economical way. But our interest in your equipment does not cease when the tools are delivered. The services of a pneumatic tool expert are at your call, and a nearby warehouse will promptly supply your wants in tools, parts or fittings. Little David is not only the name of a superior line of pneumatic tools; it is the name of a service as well."



SHIPBUILDING PLANT FOR SALE

United States Shipping Board Emergency Fleet Corporation

Invites Proposals for the Purchase of

Shipbuilding Plant, Raymond, Washington

Operated by

Sanderson & Porter

This shipyard is located 11 miles from Willapa Harbor on the Chicago, Milwaukee & St. Paul R. R., with switching connection to the Northern Pacific R. R., and has been one of the very efficient shipyards in the Northern Pacific District in the building of wood ships of 3500 D. W. T. capacity.

Detailed inventory, blueprints and photographs and other data of said shipyard have been filed in the office of the District Manager, 607 Securities Building, Seattle, Washington; in the office of the Manager of the Shipyard Plants Division, Emergency Fleet Corporation, 140 North Broad Street, Philadelphia, Pa.; and at the yard; and the same may be inspected by prospective bidders during business hours. Copies of a description of the yard and abstract of inventory may be obtained on application to any of the above and deposit of $10.00 to guarantee return.

Sealed bids will be received until 11 o'clock A. M., Sept. 10, 1919, by the United States Shipping Board Emergency Fleet Corporation, at the office of the District Manager, 607 Securities Building, Seattle, Washington, or at the office of the Manager of the Shipyard Plants Division, 140 North Broad Street, Philadelphia, Pa., for the sale of the said Corporation's Shipbuilding Plant at Raymond, Washington, including the tools and equipment thereof, said plant being now operated by Sanderson and Porter. One of the proposals will be accepted, or all rejected, within forty-five (45) days of that date.

Bids must be submitted in duplicate, on standard proposal forms, made in the manner designated therein, and enclosed in sealed envelope marked "Proposal 8005 to be opened at 11 A. M., Sept. 10, 1919." Proposal forms may be obtained from any of the offices designated above.

Bids must be accompanied by a certified check on a National Bank, payable to the United States Shipping Board Emergency Fleet Corporation, for 10% of the amount bid. This amount will be applied upon the purchase price to be paid by the successful bidder, but in the event that such bidder fails to consummate the contract of purchase, the deposit will be forfeited to the Corporation. The balance of the purchase price is to be paid within two years.

The right is reserved to reject any or all bids

United States Shipping Board Emergency Fleet Corporation

140 NORTH BROAD STREET, PHILADELPHIA, PA.

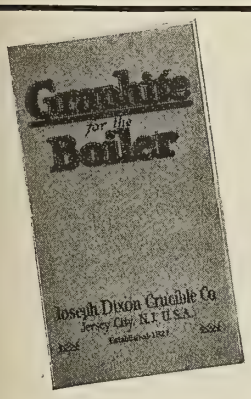
"Some Scrap in the West" is the title of a circular published by the Davis-Bournonville Company, Jersey City, N. J. "And Davis-Bournonville apparatus in the midst of it, 'cleaning it up'! That is the story of many a big scrap heap turned into easy money with Davis-Bournonville oxy-acetylene welding torches to reclaim and put into commission broken machine parts, or Davis-Bournonville cutting torches to cut up unwieldly sections into charging box size for the foundry. In this particular illustration a water-cooled welding torch is being used to weld a large broken casting which has been preheated and is covered with vulcanite paper to retain the heat. The acetylene and oxygen tanks, welding rods and fluxes are in evidence, indicating the extreme portability of the outfit in the surroundings of the 'biggest scrap heap on the Pacific Coast.'"

Pneumatic Tools are described and illustrated in a catalogue just published by the Keller Pneumatic Tool Company, Grand Haven, Mich. "In the new Keller catalogue you will find pictured and described the line of Master-Built pneumatic tools that has been adopted as standard equipment by leading railroads, Government shipyards, shops and foundries throughout the country. From the new Keller catalogue you can now buy valve and valveless drills (recent additions to the line), as well as scaling, chipping and riveting hammers, holders-on, dolly bars, jam riveters and sand hammers. There's a Keller-Master tool for every purpose—and every Keller-Master tool is the best for the purpose. If you have not already received a copy of the new Keller catalogue it will pay you to drop us a line at once, on your business letterhead, as a means of making sure that you are not overlooked. You'll be vitally interested in what the book says about Keller-Master tools; you'll find the tools themselves can be depended upon to do a great deal more than the utmost that we have ventured to claim for them."

"The Importance of a Strong Constitution" is the title of a circular published by the Coes Wrench Company, Worcester, Mass., describing the Coes "Steel-Handle" wrench. "A man who is sick most of the time cannot accomplish much—nor a wrench, both must have a strong constitution. Just as each part of the human body must contribute its share of strength, so must each part of a wrench unite with the other part for this same accomplishment. There must be no weak parts. Coes 'Steel-Handle' wrench is a good example of how strong and serviceable a screw wrench can be made when useless parts are eliminated. With a constitution made up of six solid, simple whole parts, all united by the strong Coes method, there isn't a sign of weakness in a Coes steel wrench anywhere. These two models are especially made for trying service—in moisture (hot or cold) and for heavy duty."

High Grade Bronzes for Engineering Purposes is the name of the new catalogue which has just been published by the American Manganese Bronze Company, Holmesburg, Philadelphia, Pa. This catalogue will be forwarded to any individual or concern who writes to the company on the official business letterhead. The publication contains descriptive material and illustrations on hydraulic castings, gear wheels, propellers, ingots, valves, bronze forgings, bearings and bushings, rods, rolls and shapes, etc.

A Hand Book for Eye Protection for the Industries is published by Strauss & Buegeleisen, 438 Broadway, New York. This is an interesting little publication, from which we quote as follows: "These pages contain an expanding collection of notes made at various times and frankly used as convincing arguments for our products. They are arranged in a semblance of order, but in some points (especially those which are worth it) we have added explanation to proof, and demonstration to conclusion, even at the risk of repetition. Our only excuse is that we are wrapped up in the subject of eye protection to the exclusion of all side issues; and that among safety men (all more or less technical diggers after facts) these same sets of facts and proofs have made us widely and favorably known at times to our profit—and always, we hope, to the benefit of the men in the mills."



This Booklet Shows How To Make Boiler Cleaning Easy

The antiquated method of removing boiler scale with a hammer and chisel is both expensive and time-consuming.

This little booklet shows how scale may be handled in a simple manner. It also shows the increased cost of coal due to scale forming in boilers.

DIXON'S PIONEER
BOILER GRAPHITE

is not a cure-all, but it is the most nearly perfect solution of a troublesome problem.

The formation of scale can rarely be prevented by any treatment, but flake graphite checks it from burning fast to the metal and thus renders a great service at cleaning time.

The action of Dixon's Pioneer Boiler Graphite is mechanical, not chemical, absolutely safe and harmless. Its use reduces the expense of cleaning boilers to at least one-half of what it formerly cost.

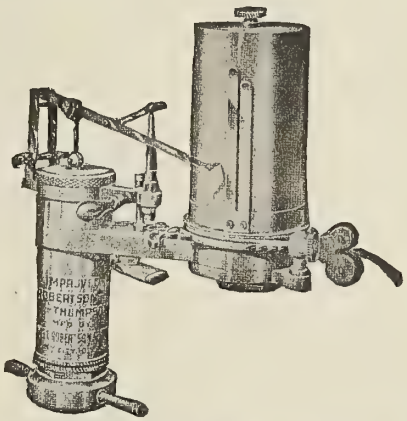
Write today for your copy of this Booklet No. 75-T, "Graphite for the Boiler."

A sample copy of "GRAPHITE", published monthly in the interest of Dixon's Graphite Products and their uses, will be sent free to those requesting. Ask for No. 75.

Made in JERSEY CITY, N. J., by the

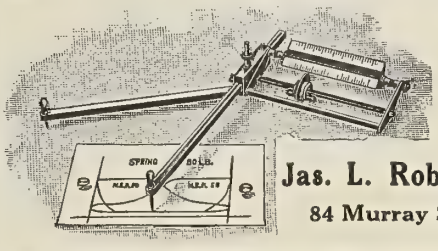
JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827



You can't feel your Engine "Pulse" without a good Indicator—Here's the Robertson-Thompson and the Willis Planimeter. THE A. B. C. WAY OF REALLY KNOWING to the absolutely accurate and direct figuring of diagrams. THEN YOU KNOW.

The prices for these instruments are lower than you ever thought of. Don't you want to know them?



Jas. L. Robertson & Sons

84 Murray St., New York

"A New Principle in Welding and Cutting Apparatus" is the name of a short bulletin which has been issued by the Bastian-Blessing Company, West Austin avenue at La Salle street, Chicago, Ill. This bulletin describes the principle of Rego torches which are used with the welding and cutting devices placed upon the market about a year ago by the Bastian-Blessing Company. "Four years of laboratory and shop tests were spent in the development of the Rego principle, whereby equal volumes of both gases are used and the flashback eliminated. Constructionally, there were certain principles which ten years' experience in oxy-acetylene welding and cutting had proven to be correct. The gases should mix in the tip, so that each time the tip is changed the mixing chamber may also be changed. This is necessary to secure correct volumes of gases at low pressures. This form of construction is also preferable because the torch can be more easily repaired; because the volume of mixed gases is always very small (not true in the torch which mixes the gases at the end of the handle), and because a defective mixing chamber does not mean faulty operation of the torch on the other tips, as it does mean with the torch which mixes the gases back of the tip. There should be no thread on the tip itself, because the torch head naturally expands when heated and contracts as it cools. So do the tips, but the rate of their expansion and contraction is invariably different from that of the head, since they are invariably of different materials. Therefore, a thread on the tip either binds or strips and is quickly ruined. The tip should be of some material other than brass or any of the compositions high in zinc, since, under the terrific heat of operation, the zinc will be fused quickly and the tip destroyed. Copper, or any alloy very high in copper, should be used. If cone seat construction is used on tip, the angle should be broad enough to prevent the tip sticking into the head, and the union nut should be so threaded that the force exerted to make the tip tight will not crack the head. These features of construction are neither new nor original. They are the result of studying all kinds of torches in operation, and ascertaining by this means the mechanical construction which is proper to withstand the abuse to which torches are always subjected. In the principle of mixing the gases, however, an original departure has been made from the existing apparatus. The Rego brings the gases to the mixing chamber with the acetylene under a slightly greater pressure than the oxygen. High pressures are not necessary. On a tip which is a size larger than ⅛ inch, the acetylene pressure is only 9 pounds. The acetylene, being slightly in excess in pressure, holds back any excess oxygen under any and all conditions; whereas in torches issuing oxygen under a heavier pressure, conditions are always present whereby an excess of oxygen must be used."

Forged Steel Flanges for boilers and tanks are described by the Scully Steel & Iron Company, Postoffice Box 814, Chicago, Ill., in a circular the company has recently issued. "We furnish forged steel flanges, threaded or blank, for all class of work. Scully flanges are forged from open-hearth steel and have heavy reep hubs with perfect threads."

"Facts for Operators of Electric Hoists" is the title of a comprehensive booklet prepared by the engineering committee of the Electric Hoist Manufacturers' Association. Another booklet on track, supports and current conductors will be issued shortly. Both these publications may be obtained from the secretary of the organization, W. C. Briggs, 30 Church street, New York City.

The Mietz Oil Engine is described in a catalogue published by the August Mietz Corporation, 428 East Nineteenth street, New York. "A saving of 40 percent is accomplished under actual service conditions, not manufacturers' test. The pioneer of this type operating on low-grade fuels exclusively. Does not use any of the high pressures and is free from the use of complicated auxiliaries, and does away entirely with electric ignition devices, carburetors, valves, etc. Built in sizes from 40 to 350 horsepower, in both reversing gear and direct reversible types. Gives a maximum of simplicity, reliability, durability and economy in every respect. Used by the United States Government, foreign governments and the merchant marines of the world. We also build stationary engines for all power purposes. Send for data, stating your requirements."

"Magnetic Chucks" is the title of an illustrated 44-page catalogue published by the Heald Machine Company, Worcester, Mass. "The use of magnetic chucks for holding work to be machined has greatly increased during the past few years, especially among progressive manufacturers who are looking for the best and most productive methods. These manufacturers have found the magnetic chuck not only more efficient and quicker to operate, but in many cases less expensive to install than special fixtures that would be necessary for the same work. This is true not only in their application to grinding machines but also to milling machines, planers, shapers, lathes, etc. In fact, the possibilities of magnetic chucks and the variety of work that can be handled by them are so great that they must surely gain rapidly in popularity as their merits become better known. One of the best investments a machine shop can make is to install magnetic chucks for many of its grinding, milling, planing and turning operations. The adoption of magnetic chucks will often increase the production of a machine 50 percent or more by the elimination of lost time in setting up the work."

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HELP AND SITUATION AND FOR SALE

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Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Practical Marine Foreman and Engineer wishes connection with repair shop. Would act as foreman and invest $3,000 to $5,000. Locate anywhere. References. Address *Box* 66, care of Marine Engineering.

Shipbuilder, with 18 years' experience in leading yards and New York harbor work, seeks responsible position as designer or naval architect, or would act as consulting engineer to parties contemplating extension of present fleet. Address *Designer,* care of Marine Engineering.

Marine Oil Engines for Sale—Four 100-horsepower Fairbanks-Morse new oil engines; four 350-horsepower Diesel engines; two 500-horsepower Diesel engines; one 25-horsepower Fairbanks-Morse type "Y" crude oil engine. *Inland Navigation Company, Inc.,* St. Louis, Mo.

An Aggressive Salesman, who has a thorough first-hand knowledge of ships, shipping, shipyard requirements, and a wide acquaintance along the Atlantic Coast, has opened a Manufacturers' Agency, with headquarters in New York City. Manufacturers who wish representation, on a commission basis, by an agency using trained salesmen, experts in advertising and selling, who can place your goods throughout the East, should "establish communication" with a man who is in the habit of getting results. Address *Salesman,* care of Marine Engineering.

Joiner Draftsman—Graduated from good school; thirteen years' experience from different shipyards, and has the last seven years had charge for all joiner work on both cargo and passenger vessels, wants to change position. Address *Joinerman,* 1919, care of Marine Engineering.

Diesel Engineer—Wanted immediately for a responsible and permanent position a competent and experienced Diesel Engine Engineer. Must be able to take complete charge of Marine Diesel engineering and designing work. Location New York. Address *Box* 85, care of Marine Engineering.

High-Class Engine Designer Wanted, also draftsmen, tracers and designers for structural and mechanical work on boats, derricks, etc. Good salaries and permanent position to the right men. Address *Chief Engineer, The Dravo Contracting Company,* Engineering Works Department, Pittsburgh, Pa.

Superintendent or Works Manager available. Capable of taking charge of drydocks or floating docks and all hull repairs and refrigeration installations. Many years' experience with leading British and Canadian firms. Can make estimates on hull repairs. Personal interview desired. Address *Box* 505, care of Marine Engineering.

For Sale—One 13-inch General Electric type P. C. thirteen, twenty-ampere, one hundred fifteen-volt direct-current searchlight, complete with rheostat, overhauled and in A-1 condition. Three 67-foot and three 75-foot cargo booms in good condition. Address *Freeport Sulphur Company,* Freeport, Tex.

Designing and Detail Draftsmen—For permanent positions with large manufacturing concern in New England. Men with electrical, steam engine, turbine or special machine experience. Apply, giving age, experience, education and salary expected by addressing *Chief Draftsman, Box No. 90-X,* care of Marine Engineering.

Graduate Naval Architect, now in Government service, desires place as general superintendent. Familiar with office and outside work on hull and engines and modern shop practice. Specialty, the logical application of bridge shop methods to hull construction. Address *Box* 375, care of Marine Engineering.

Designing Engineer—Wanted immediately a Marine Designing Engineer for a responsible and permanent position. Good opportunity for right man. Must be able to take complete charge of specifying, designing and ordering material for steam vessels. Must have good education and experience. Location New York. Address *Box* 74, care of Marine Engineering.

Oil Engine Drawings for sale in full sets of standard shop working drawings. For 5,000- and 9,000-ton steamers, four-cylinder, 24 by 36, 1,450 horsepower, by 96 sheets, $2,200; for tugs, four-cylinder, 18 by 27, $1,000, and four-cylinder, 16 by 24, $900. For yachts or as auxiliaries, steel column crosshead type, 10 by 12, $900; 6 by 8, $600; 4 by 5 trunk piston, $300. Address *Fuel Oil,* care of Marine Engineering.

"For Speedy Production" is the title of Arc Welding Bulletin No. 104-O, published by the Lincoln Electric Company, Cleveland, Ohio. "The answer to the urgent call for speedy production is found in the Lincoln arc welder."

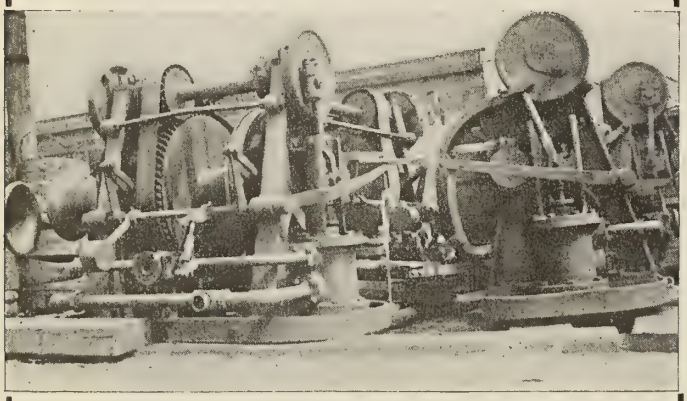
A Ten-Foot Gate Shear is described in Catalogue O-930, issued by Bertsch & Company, Cambridge City, Ind. "Ten-foot gate shear for shearing 1¼-inch plates. Made in all standard sizes. We have had forty years' experience designing and building this class of machinery, also bending rolls, punches and presses. Any size up to 150 tons in weight."

A One-Man Roll Table is described in illustrated Bulletin 6-BY, issued by the Thomas Spacing Machine Company, 1226 Fulton building, Pittsburgh, Pa. "A convenient, moderate priced equipment, which facilitates the handling of plates, etc., in punching with single punch eliminates jib cranes and helpers. By its use as high as 7,000 holes can be punched in nine hours."

Meeting Engineering Demand has been a great accomplishment of the American Spiral Pipe Works, Chicago, Ill. The company has just issued an unusually handsome catalogue of 88 pages, profusely illustrated by half-tone engravings, showing some of the company's actual production. In addition there are several plates. The American Spiral Pipe Works manufactures Taylor's spiral riveted pipe, special pipe fittings, lap welded steel pipe, forged steel pipe flanges, the Taylor seamless forged steel boiler nozzle, corrugated furnaces of several types for land and marine boilers, and similar engineering work. The catalogue states, "These pages may have shown you a solution to your particular problem of construction—but if not, consult our engineering department at any time. Our real accomplishment has been that of meeting engineering demands as they presented themselves, frequently anticipating this demand because of our specialization in this field."

The Nash Hytor, a pump for air and gas, vacuum or pressure, is described in a circular published by the Nash Engineering Company, South Norwalk, Conn. "The advantages of the Hytor are many. There is only one moving part, the rotor, molded in one piece with heavy shrouds cast integral. This is keyed to a sturdy shaft, rotating on annular ball bearings mounted outside of casing. The rotor revolves with a clearance. There are no sliding vanes, loose-moving or reciprocating parts in the pump. Interior lubrication is therefore not necessary, and the air is delivered absolutely free from oil, dust or metal particles. As several blades act simultaneously, the Hytor delivers air absolutely without pulsation. Various liquids may be used in the casing as the displacing medium. This permits the handling of acid gases, a liquid being adopted which protects and neutralizes the effect of the gas upon the metal of the pump."

Eight Steam Winches Almost New.—Bargain For Quick Cash Sale



Each weighs 5000 lbs. and is of Reversible two cylinder type, worth $1,300.00 new.

FOR PARTICULARS ADDRESS

STANDISH CHARD
2 Rector Street New York City

"Wire your ships against fire"

TRADE
FDW SYSTEM
MARK

AUTOMATIC FIRE ALARM

Fire Detecting Wire Co., Inc.
2 West 45th Street New York
Telephone 3526 Vanderbilt

Designer with good practical and theoretical experience in Diesel Engines and Surface Ignition Engines, willing to take position in Sweden. State references, experience and salary wanted.

Bolinders Company
30 Church Street, New York City

FOR SALE

Triple Expansion Marine Engine 18″ x 32″ x 54″—42″ stroke. Has been in service fifteen lake seasons in a wooden steamer of 3000 tons capacity. Has been thoroughly overhauled and is in A-1 condition. Shipping weight approximately 70 tons.

Windlass, 8 x 10 of Providence manufacture, suitable for 1¾″ stud link chain. Arranged for capstan drive. In first class condition.

Both subject to inspection. Immediate delivery.

McDougall-Duluth Company
Duluth, Minn.

FOR SALE

To reduce our stock of surplus war materials we offer for immediate sale the following:

Clear and Common Oak, 1″ to 12″ thick; 12′ to 40′ long.

Clear White Pine, ½″ to 3″; 6′ to 16′ long.

Spruce, Cedar, Mahogany, Ash, Elm, Long Leaf Yellow Pine,
Hackmatack Knees, all sizes.

Brass and Iron Marine Hardware, Woodworking Machinery.

If interested, apply promptly to

THE MATTHEWS COMPANY
PORT CLINTON OHIO

FOR SALE
QUICK DELIVERY

Diesel Motor Cargo Vessel "CERRITO." Principal dimensions are as follows: Length 170', Breadth 25', Depth 16', Draft Loaded 10' 6". Speed when loaded 6 to 7 1-2 knots. Single Screw. Powered with a 240 B. H. P. "Nelseco" Heavy Marine Oil Engine.

Now in active trade in Gulf of Mexico Waters. Low operating cost and a money-maker.

For further information write

The New London Ship & Engine Co.
GROTON, CONN.

WANTED

Hull Draftsmen for Steel Shipyard in South. Must be experienced in modern merchant practice and familiar with rules of classification societies. Only competent men of pre-war experience need apply. Give full particulars in first letter.

Box 2, MARINE ENGINEERING
6 East 39th Street, New York City, N.Y.

Wanted—Shipyard Executive

Duties, general supervision with exception of office routine. None considered who had not received a salary in excess of $4000.00 a year prior to 1914. Reply with full record, giving details of education, shipyard experience, salary expected, etc.

Address, Box 516,
care of MARINE ENGINEERING.

Faessler's new line of roller expanding and flaring tools for stationary, marine and locomotive boilers is described in an illustrated catalogue just issued by the J. Faessler Manufacturing Company, Moberly, Mo. "These new expanders, first shown to the trade at the Chicago convention, are the latest development of Faessler's thirty-five years' experience and specialization in the making of boiler makers' tools. Each is for hand operation, is self-feeding and performs a perfect job of rolling the tube tight in the sheet and also flaring or belling to any desired angle up to 45 degrees. Both expanding and flaring operations are done with the same tool, which is not removed from the tube until the work is completed. Our process does not pinch or thin the tube at the bottom of the flare and the outside edge of the sheet. Made throughout of heat-treated and tempered steel, these tools are extremely durable and wear is reduced to a minimum. They insure better, faster and easier work, in both construction and repairs. In ordering please give both the outside diameter and the gage of the tool. Let us send you our catalogue and show you how you can add to the speed and effectiveness of your boiler work."

Accurate Centering secured by the use of the Cleveland Foating Punch. This is the subject of a bulletin published by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "Equip your punching machines with the Cleveland (patented) floating punch attachment and you will not only get accurately centered holes but also increased production. The Cleveland floating punch attachment is used for punching plates that have been laid out with prick marks denoting the location of the holes to be punched. The center point marks are easily located, for the reason that the floating punch rests on the material at all times following every undulation of the surface. The punch is forced by the power stroke through the material, on the return stroke it is stripped clear and again returns to the plate ready for the next power stroke."

Welding Locomotive Fireboxes.—Realizing that the practice of welding locomotive fireboxes instead of riveting is receiving increased attention in locomotive shops, the Air Reduction Company, New York, has published a booklet describing the Airco process of oxy-acetylene welding as applied to this character of work. The booklet is designed to help the operator by showing him the proper methods to follow when welding a firebox. It describes the operation necessary for full and semi-welded side sheets, cracks in side sheets, full welded door and flue sheets, patches on fireboxes and flue sheets, patches on mud-ring, welding of door collars and door holes, building up worn edges of fireboxes, etc. Full-page drawings illustrate the different operations.

The "Buffalo" Ball Bearing Drill is described in a circular published by the Buffalo Forge Company, Buffalo, N. Y. "This machine has a strong, well ribbed frame with shafts and spindle of steel, carefully turned and fitted. Two feeds, hand and automatic, are provided—the latter being adjustable to three speeds. Has one-spindle speed. A hardened steel ball bearing takes up friction between spindle and feed screw. Table is slotted and can be easily raised or lowered or swung aside, out of the way when desired. Fitted regularly with Buffalo improved chuck."

"They Say Seeing is Believing" is the title of a circular issued by the J. Faessler Manufacturing Company, Moberly, Mo. "That's why we want you to try out one of our Faessler safety sectional expanders and see for yourself how one man using it can do twice as much work as two men with ordinary equipment. All Faessler tools are built on the same principle—to make labor lighter and to increase working speed. Those boiler shops who have tried them are using them in preference to all others, and the increased output they have been able to show in spite of the reduction in working forces is convincing proof that Faessler tools are faster tools. Prove this for yourself. Our sixty days' free trial offer is open to you. We build everything in boiler-making tools and special tools for special uses if required."

Seven of the eight are now accepting orders

DURING the war, notwithstanding the fact that our factories produced more than ever before, it was sometimes impossible for us to guarantee delivery dates even months in advance.

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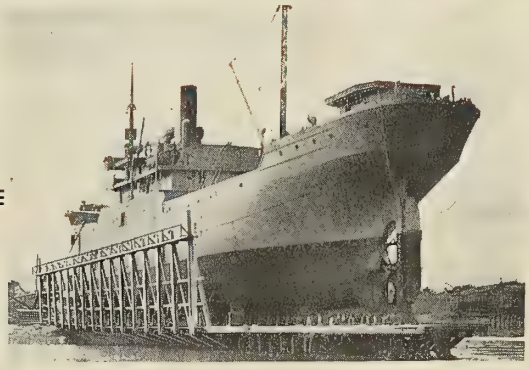
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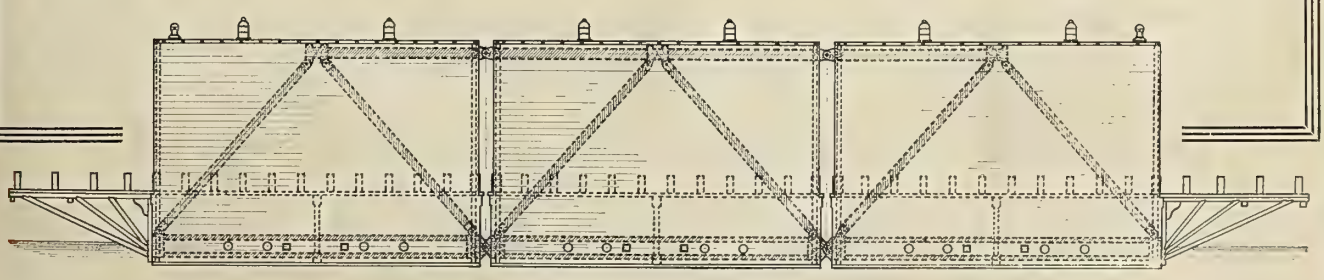
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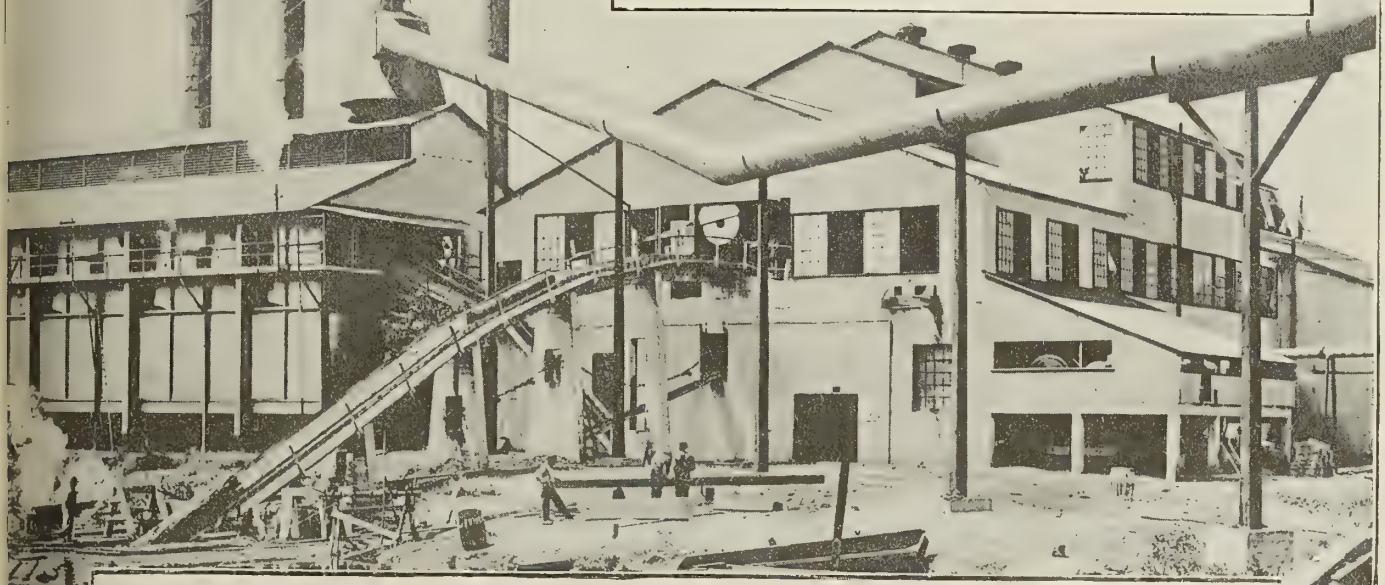
As is the case with most lumber mills, so plentiful is the supply of wood fuel that a big incinerator runs day and night to burn up the waste of slabs, cuttings, sawdust, etc. which is not only valueless but a positive nuisance.

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Photo courtesy by W. H Fleming, Birmingham, Ala.

TRADE PUBLICATIONS

"The Best Machine Tools for Marine Equipment Manufacture" are described by the Niles-Bement-Pond Company, 111 Broadway, New York, in various catalogues. "We build machinery for ship shed use—keel bending machines, plate planers, garboard bending machines, flanging presses, shears, radial drills—machinery for the manufacture of the heaviest boilers, special equipment for handling armor plate, guns and gun mounts. For marine engine and steam turbine manufacture our line of heavy-duty machinery is representative of the best practice in tool construction, and can be used with excellent results. Besides this equipment we also build a complete line of steam hammers, comprising forge, drop, board drop and tilting hammers in capacities up to the largest ever built. They are entirely dependable and are designed to operate continuously with the least attention. We also build Pratt & Whitney precision machine tools. As originators of the system of interchangeable manufacture, the line of precision machine tools, as developed in our Pratt & Whitney shops, is unequaled for accuracy and refinement. Many of the machines that go out under the Pratt & Whitney name are practically automatic in action, and are designed to permit the accurate machining of intricate and delicate parts without requiring highly skilled attention. We mention some recent additions to our line which are special and original with us: automatic milling machines, horizontal automatic profiling and cam cutting machines, vertical shapers, jig boring machines, contour cutter grinder. Niles cranes will be found to answer the various requirements of shipyard and drydock, as they include electric traveling cranes from 5 to 250 tons, and larger capacity, gantry cranes, yard cranes, wall cranes, as well as grab bucket hoists and trolleys. Pratt & Whitney small tools enjoy an enviable reputation for high quality that has been well earned in the production shops of the country. In shipyards and railroad shops, where stamina as well as accuracy are required of the small tool equipment, Pratt & Whitney tools have more than held their own. We can honestly recommend them—our line is complete. Prompt service is assured at our nearest store, where P. & W. small tools are carried in stock for immediate delivery. Place your order there today. We will be glad to send you copies of our catalogues 'Small Tools,' 'Gauges and Standards.'"

"Propellers in a Nutshell" is the title of a booklet published by the Columbian Bronze Corporation, 50 Church street, New York, from which we quote as follows: *"Tampa,* one of the ten sister cargo ships being built to the order of the Emergency Fleet Corporation by the Oscar Daniels Company, Tampa, Fla., is 416 feet in length, 53 feet beam, 28 feet molded depth, with a deadweight capacity of 9,600 tons. Her propeller equipment, through which her 2,800 shaft-horsepower drives her at 11 knots, is worthy of mention, as indicating our ability to handle propeller castings of almost any size required. The 17-foot by 15-foot 6-inch sectional type-wheel is fitted with four 3,800-pound blades of Columbian manganese bronze, cast by us at our foundry at Freeport, L. I.; the cast iron hub and machine work are by Hardie-Tynes Manufacturing Company, Birmingham, Ala. We manufacture complete steamship and motor ship propeller equipment, including propellers; intermediate and tail shafts in bronze and steel up to 10 inches in diameter, in bronze up to 5 inches; shaft couplings; stern tubes; stern bearings, babbitted or lignum vitæ lined—all to Lloyd's specifications where required or to your specifications otherwise."

"Industrial Transportation" is the title of a booklet issued by the Bicycle Manufacturers' Association, 30 Pearl street, Hartford, Conn. This booklet has been issued to call the attention of industrial concerns to the advantage of the bicycle as a method of transportation for working men and women. No mention is made of the name or manufacturer of any bicycle. A copy of the booklet will be sent free to any of our readers upon request.

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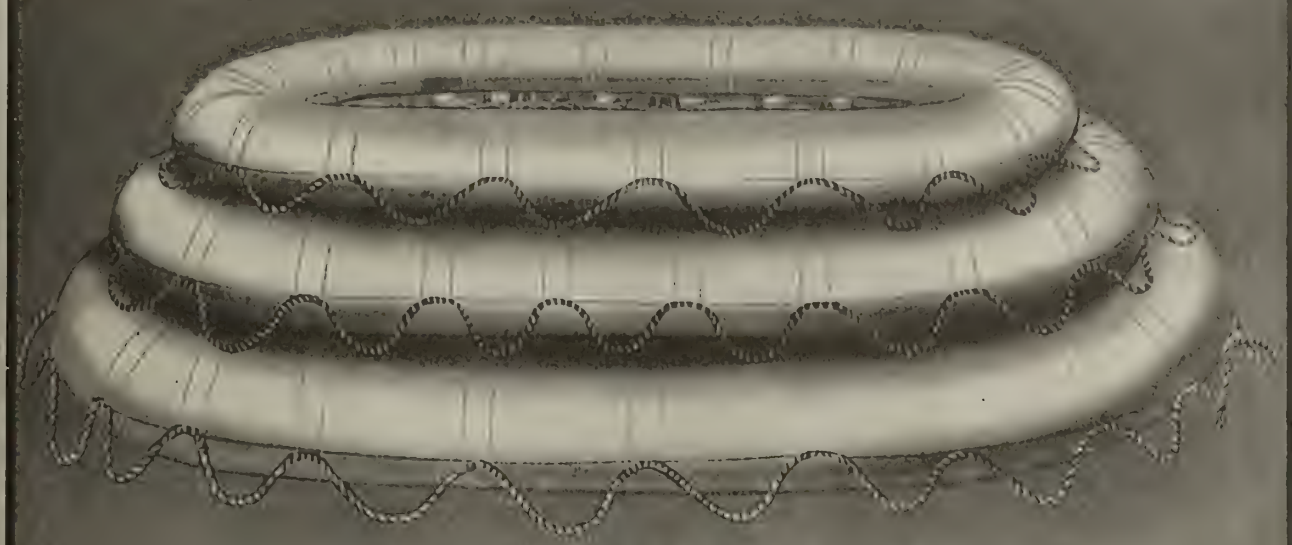
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The Automatic Tension Towing Engine is described in an illustrated catalogue which has just been issued by the Lidgerwood Manufacturing Company, 95 Liberty street, New York. This is said to be the essential element in the Lidgerwood-Miller marine cableway for transshipment at sea of coal, ammunition, supplies, mail, etc., and for life-saving at sea. "The Automatic Tension Engine has double horizontal cylinders, with one rope drum mounted either on the crankshaft or on a second shaft geared to the crankshaft. This drum is connected to its shaft through the medium of heavy springs, allowing a limited rotation of the drum on the shaft independent from the rotation imparted to it through the shaft itself. Changes of tension in the rope cause the drum to rotate slightly on the shaft, either against or in the direction of the spring pressure. This motion of the drum operates a controlling valve which raises or lowers the steam pressure as required to maintain a constant tension upon the rope. The spring is therefore a feeler or detector of tension changes. The action is instantaneous, and no appreciable interval of time elapses after a change in tension before there is a compensating change in steam pressure. The steam for operating the engine is introduced into the cylinders through a novel form of controlling valve. This valve regulates the amount and pressure of the steam supplied to the cylinders. Mechanical elements connect the drum and the valve, so that the movement of the drum, caused by variations of the tension in the rope, is transmitted to the valve, and the steam admitted through the valve always bears a definite relation to the tension in the rope. A slight increase of tension causes a reduction of steam pressure, permitting the rope to overhaul the engine and restore the tension to normal. A slight reduction of tension causes an increase of steam pressure, causing the engine to take up slack in the rope and restore the tension to normal. The tension developed by this engine in pulling in is slightly less than the resistance set up to overhauling. The tension or stress in the rope is controlled within 10 percent of uniform. In addition to the automatic control of tension fluctuations, there is provided means for manually regulating the tensioning capacity up to the maximum for which the engine is designed."

The New Line of Faessler Expanders is described in an illustrated circular issued by the J. Faessler Manufacturing Company, Moberly, Mo. "Although it is less than three months since the new Faessler line of spiral expanders was introduced to the trade at the Chicago convention, these tools have created a profound impression. Locomotive superheater tubes, locomotive arch tubes, stationary, watertube and marine boiler tubes. They are admirable in every respect—perfectly balanced in design, easy to operate, exact in their work, and, being made throughout of heat-treated and tempered steel, are extremely durable. All the qualities requisite for fast, clean and accurate flaring and expanding are embodied in these latest products of a firm which for thirty-five years has devoted itself entirely to the designing and manufacturing of boiler makers' tools of the highest grade. If you wish your men to perform the best work possible you must furnish them with the best expanders—that is, Faessler's."

W S M Automatic Ore Unloaders are described in Bulletin 27, just published by the Wellman-Seaver-Morgan Company, Cleveland, Ohio. "This automatic unloader is unique in design and has proved through many years of service to be one of the most successful devices for unloading ore cargoes from lake steamers that has ever been devised. Although of immense proportions, the design has been simplified and the control perfected to such a point that the machine is the last word in delicacy of control and operation. A record was made in Ashtabula by eight machines of this type having a capacity of 15 tons each, unloading seven boats having a total capacity of 70,000 tons in 22 hours' actual time. At other points, four machines working in boats having capacities up to 13,000 tons have unloaded these cargoes in about three hours and twenty-five minutes."

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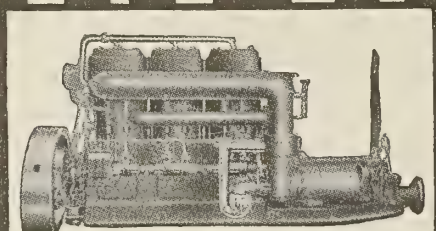
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"How This Plant Meets the Emergency" is described in a circular published by the Pawling & Harnischfeger Company, Milwaukee, Wis. "In every wearing mechanism there is a time when some part requires replacement. When it is so fundamental to production as a crane or hoist, a temporary disablement assumes the proportion of a serious emergency. It is then that the crane or hoist user relies upon its builder for immediate aid. At no other time is the value of standardized equipment so forcibly brought home to him. P & H cranes and hoists, though built to meet specific dimensions and requirements, are completely standardized in their component wearing parts: gears, gear cases, brackets, couplings, shafts, axles, bearings, truck wheels, sheaves and breaking equipment. These parts are manufactured in quantities and placed 'on the shelf,' ready for the emergency. When an order for a renewal part is received it passes immediately to the renewal order department, whence it is routed through stock and shipping departments with special dispatch. In all extremely urgent cases the shipments are immediately followed by 'tracers' to avoid delays in transit. But a short time ago a prominent tractor manufacturer near Chicago 'long-distanced' us that a bridge truck wheel on his crane had broken, making further operations hazardous. The new wheel ordered lay at his door the following day. That is how P & H service meets the emergency. We are able to give such degree of service on cranes and hoists of earlier standards; the part-standardization system having been in practice since the early days of our organization. Quantity production of standard crane parts carries with it an advantage fully as important as the renewal feature, namely, speed in crane building. A P & H crane, from girders to motors, is fabricated entirely in the P & H plant; we are manufacturers, not assemblers. During the war period a P & H crane for an Eastern ordnance plant was built and shipped complete in two weeks' time. Such accomplishment would have been impossible had we been dependent on outside sources for competent crane parts. That is how P & H met an emergency."

Electrolytic Oxygen is described in a booklet published by the Gas Products Association, 801 Marquette building, Chicago, Ill. "The term electrolytic, as applied to oxygen, means gas of the highest efficiency for cutting and welding processes. Electrolytic oxygen is sold commercially 99.5 percent pure or better. Produced by the electrical decomposition of distilled water, it is the only oxygen free from nitrogenous impurity. When electrolytic oxygen is used the welder does not have to slow up his operation for fear of nitrogenization. A booklet issued by an oxygen manufacturer who does not use the electrolytic process contains this interesting admission: 'Probably the most important property for the steel of a frog weld to possess is that of ductility. This may be seriously affected by the wrong method of producing the fusion of the joint. Under certain conditions of melting steel the nitrogen of the air may be separated from the oxygen and charged into the molten metal of a weld. The result would be to spoil the ductility of the weld by making it very brittle.'"

"The Pyrograph—A Boiler Cutting Machine," is the title of a booklet just published by the Davis-Bournonville Company, Jersey City, N. J. The pyrograph is stated to be a remarkably efficient device for trimming and beveling flanged boiler sheets, and the statement is also made that very few mechanical engineers or boiler makers will realize what saving of time and labor can be accomplished in the boiler shop with one of these machines. "The Pyrograph (fire writer) is a cutting machine primarily designed for beveling the edges of boiler heads, combustion chamber heads, flue sheets and other steel parts that require trimming after the flanging operation and beveling to the calking angle. The machine trims the sheets with a cutting torch to the required length and bevels them in one and the same operation. It eliminates costly and slow hand of pneumatic hammer chipping on flanged boiler work, being adaptable to all shapes of flanges. In one shipyard boiler plant flanged combustion chamber heads ¾ inch thick, having a flange periphery of 27 feet, are trimmed and beveled to the calking angle in one-half hour, exclusive of setting-up time."



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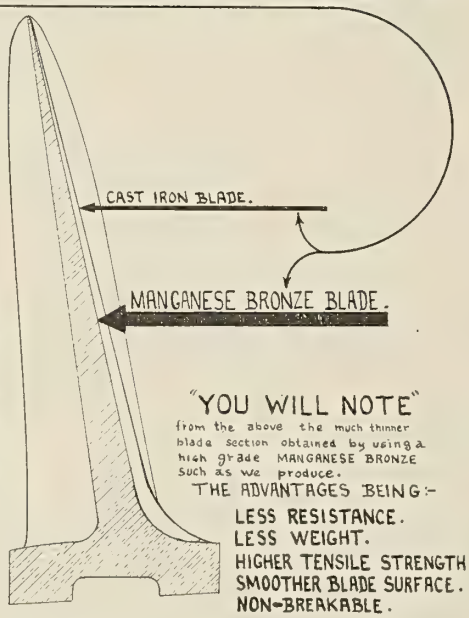
Electric Air Compressors, portable electric drills and electric valve grinders are described in an illustrated catalogue published by the Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore, Md. "The quality of any mechanical device is dependent upon three fundamentals—design, material, workmanship. Long before the first Black & Decker Lectroflater electric air compressors or portable electric drills were placed on the market the Black & Decker Manufacturing Company designed and built special machinery, such as currency presses for the United States and Canadia Governments, postage stamp machines, duplicators, milk bottle cap machines, moving picture cameras and projectors, shoe machinery and special tooling for other manufacturers' production work. During the war they made, in addition to the regular line of Lectroflater electric air compressors and Black & Decker portable electric drills, such precision apparatus as gun sights for naval rifles, breech mechanisms for airplane cannon, demolition and incendiary bomb firing mechanisms, etc. It is obvious that sound engineering ability must be the basis of such work, and one logically expects—and finds—the predominating feature of Black & Decker products to be their advanced design."

"Thacher Process Propellers" is the title of a 12-page catalogue which has just been published by The Thacher Propeller & Foundry Corporation, Albany, N. Y. "Ship motion is entirely generated by the propeller. Its importance must therefore be recognized by marine engineers. Propeller design is a subject that can be mastered only by the constant and exclusive experience and study of a specialist. That some propellers give good results proves that good design is essential. A better design gives better results. We have in charge of our design an engineer who has always specialized in propeller design; who has made more designs, and proven their success, than perhaps any other marine engineer. We make propeller wheels to any design, but advise that propeller design be made for ship conditions in their entirety. The designing charge is a small part of propeller cost, and its resulting serving will return the investment innumerable times. When an order is placed with us we include the design at no additional cost. Our material melting and metals department is under the guidance of a metallurgical engineer and chemist of national reputation. Every wheel made by The Thacher Propeller & Foundry Corporation is poured of metal mixed by chemical formula. The propeller material after pouring is chemically analyzed and tested for tensile strength, and a full report of tensile strength and measurement data furnished with each wheel. We are making propeller wheels with a complete realization of their importance to successful ship operation, and toward that end spare no expense in equipment, patterns, material, testing and finishing. It is not our intention to compete in price with the commercial propeller wheel. Quality is our only aim, not quantity."

How to Make Boiler Cleaning Easy.—The Joseph Dixon Crucible Company, Jersey City, N. J., has issued a new booklet, "Graphite for the Boiler," which tells in a clear and concise way how to make boiler cleaning easy. The unusual part of this little book is that it does not claim that boiler scale can be entirely prevented but that it can be made easy to remove. An interesting table is included which shows the extra cost of coal due to the various thicknesses of scale present in boilers. The manufacturers will be glad to send a copy of this booklet, No. 75-T, to anyone interested.

"Marine Hardware" is the title of a profusely illustrated cloth-bound catalogue which has just been published by Sargent & Company, New Haven, Conn. In the catalogue is given, numerically arranged, a list of the United States Shipping Board Emergency Fleet Corporation specifications under which hardware shown in the catalogue is acceptable, with the pages on which the different items appear. Also a list of United States Navy specifications, with the pages on which the different items appear. This catalogue should be in the hands of everyone interested in marine hardware, and a copy will be sent to any of our readers upon request.

"WHY HESITATE?"



MORAL.
If you want STRENGTH use Manganese Bronze . . .
If you want the STRONGEST. use . . . . .
S.M.B. Brand

"YOU WILL NOTE"
from the above the much thinner blade section obtained by using a high grade MANGANESE BRONZE such as we produce.
THE ADVANTAGES BEING:-
LESS RESISTANCE.
LESS WEIGHT.
HIGHER TENSILE STRENGTH.
SMOOTHER BLADE SURFACE.
NON-BREAKABLE.

WE HAVE MADE
PROPELLERS
FOR MANY OF THE
LEADING SHIPYARDS

WE ARE EQUIPPED TO HANDLE THE LARGEST PROPELLERS DESIRED, AND ALSO TO SUBMIT PRICES ON

PROPELLER PATTERN MACHINING DESIGNING

AMERICAN MANGANESE BRONZE CO.
HOLMESBURG, PHILA., PA.
(*MANUFACTURERS OF SPARE'S BRONZES*)

New Jersey Zinc

The world's standard for Zinc products

ZINC PLATES

Our numerous mines yield such a comprehensive variety of zinc ores that we are able to exactly meet every zinc requirement.

Our rolling mills at Palmerton, Pa., are now prepared to furnish zinc ship plates and boiler plates of any desired dimensions and thicknesses and of just the right quality to best serve their purpose.

This organization with its extensive resources and its seventy years of experience in the development and production of zinc products, has unusual advantages in meeting the needs of the ship building industry.

THE NEW JERSEY ZINC COMPANY, *160 Front Street*, New York

ESTABLISHED 1848

CHICAGO: Mineral Point Zinc Company, 1111 Marquette Building

PITTSBURGH: The New Jersey Zinc Co. (of Pa.), 1439 Oliver Building

The Peterson Marine Type Oil Filters is described in Bulletin S-26, published by the Richardson-Phenix Company, 120 Reservoir avenue, Milwaukee, Wis. "During the war part of the standard engine room equipment of practically all of the ships built for the Emergency Fleet Corporation was a Peterson marine type oil filter. Oil does not wear out; it merely gets dirty; remove the dirt and the oil can be used again. The Peterson marine type oil filter is guaranteed to purify used oil so that the lubricating properties of the filtered oil are equal to new oil. Peterson marine type oil filters are used because they save oil; they save cargo space by reducing the amount of oil that must be carried; they make a ship practically independent of the varying oil supply at foreign ports. If they were a good investment during the war, surely they are a necessity in peace. Designed for marine service the Peterson oil filter can be easily cleaned without stopping its operation; there are no moving parts to get out of order or to replace."

"A Great Combination" is the title of a circular published by the American Engineering Company, Philadelphia, Pa. "In fact, it is rightly called 'the Ideal Combination.' The Benson electric telemetor is simple, positive and instant in operation. Not affected by air pockets or temperature changes. Always ready to work, practically fool-proof, absolutely accurate, low in running expense. The American electric hydraulic steerer —prompt and powerful in action, accurate, sensitive, great holding power with ample provision for relief and recovery in case of overstrain due to heavy seas, economical in operation, and can be built to meet any particular space requirements. In proportion to its size it is the most powerful steerer built. You will be satisfied with the combination."

Williams' "Vulcan" Drop-Forged Chain Pipe Vise is described in a booklet published by J. H. Williams & Company, 61 Richards street, Brooklyn, N. Y. "These vises are unbreakable, compact, rapid in action and positive in gripping pipe. They are attachable anywhere—any handy bench, post or other support will serve. They are made entirely of wrought steel; the drop-forged jaws are steel-tempered for file sharpening and the hand-made chains are of the same superior quality as those of our well-known 'Vulcan' chain pipe wrenches. Vises in three sizes for ⅛- to 8-inch pipe. Remember, Williams' chain pipe tools have been standard for nearly half a century—they are all backed by our absolute and unconditional guarantee of service."

"The Right Valves for Any Pump" are described in a catalogue published by the United States Rubber Company, 1790 Broadway, New York. "The exacting requirements of marine service demand the use of rubber pump valves especially designed for the work they must perform. Upon the valves depends largely the efficiency of the pump. Marine engineers will find it advantageous to specify United States pump valves for service on hot water boiler feed, condenser and air, fire and bilge pumps, etc. Consult our engineering department in regard to the conditions the valves are required to meet. This service is free. There is a United States pump valve to meet every condition of service."

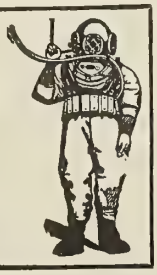
A General Catalogue and price list is issued by the Kennedy Valve Manufacturing Company, Elmira, N. Y. 122 pages; illustrated.

"Why Buy Ship Grating Outside?" is the question asked in Catalogue 2A10, published by Irving Iron Works Company, Long Island City, N. Y. "For the matter of that, why buy anything outside—engines, boilers, blowers, anchors, for instance? Simply because engines, boilers, etc., made by specialists are made better and at less cost than you could make them. Same way with grating—made as a specialty by grating specialists, it's made better and at less cost. We were the first specialists in gratings —we make more gratings to-day than anyone else. That means quantity production, better quality, lower price. Why not put your grating specifications up to grating specialists—which means, to us?"

INSIST ON HAVING
JEFFERY'S MARINE GLUE
In all the various grades it is the best for the money—the most serviceable. Pound for pound it will go further and do a better and a more lasting job than any other make. Do not be deceived by cheap imitations; see that the trade mark is on every package.
Send for booklets: "MARINE GLUE—WHAT TO USE AND HOW TO USE IT" and "HOW TO MAKE YOUR BOAT LEAK PROOF"
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Vessel Repairs in Wood and Iron
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221 HIGH ST., BOSTON, MASS.
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Triple Expansion Marine Engine 18" x 32" x 54"—42" stroke. Has been in service fifteen lake seasons in a wooden steamer of 3000 tons capacity. Has been thoroughly overhauled and is in A-1 condition. Shipping weight approximately 70 tons.

Windlass, 8 x 10 of Providence manufacture, suitable for 1¾" stud link chain. Arranged for capstan drive. In first class condition.

Both subject to inspection. Immediate delivery.

McDougall-Duluth Company
Duluth, Minn.

"Monel Metal" is the title of a catalogue published by the International Nickel Company, 43 Exchange Place, New York. "The United States Government and many prominent shipbuilders were quick to realize the great strength and durability of Monel Metal and its immunity from the corroding action of water, steam or acids and from salt-air exposure. Their engineers specify Monel Metal for pump rods, pump liners, valves and valve seats, and for use in exposed locations on shipboard, such as stair-nosings and handrails, because other metal products last but a comparatively short time under nautical conditions. The British, Japanese and Italian navies, as well as our own, use Monel Metal extensively for shaftings, pump rods and various engineering and fitting purposes. In service, Monel pump rods acquire a smooth, glass-like polish, which reduces friction to a minimum, lessens wear on packing, prevents leakage, and thus effects great savings in power and upkeep. Packing does not harden, and this, coupled with the non-corrosiveness of Monel Metal, virtually eliminates scoring and pitting of the pump or piston rod. Monel Metal is a natural alloy of nickel and copper—strong as steel—tough and ductile. Withstands acids, high temperatures and erosive action of hot gases and superheated steam. Can be machined, cast, forged, brazed, soldered and welded by electric or oxy-acetylene method. Takes and retains a perfect nickel finish. Monel Metal is manufactured in the form of rods, castings, forgings, wire, strip stock, sheets, etc. Some of its common uses, other than marine, are valve trim, stuffing boxes, auto fittings and parts, mine screens, pickling pins and storage battery casings. The Monel booklets show the many uses for which Monel Metal has proved superior. Write us for detailed information as to whether Monel Metal could be substituted with economy and greater satisfaction than the material you are now using. Our technical and research department is at your service."

Electric Arc Welding.—The Westinghouse Company has recently issued an elaborate publication covering the process of electric arc welding and the necessary apparatus required. This publication compares the different processes of welding, such as autogenous welding, forge welding, oxy-acetylene welding, thermit welding, and shows the advantages of electric arc welding over these. Some of the advantages of electric arc welding claimed are: 1, Economy; 2, ease and convenience of application; 3, speed of operation; 4, reliability of results; 5, reclaiming defective material; 6, safety; 7, conservation of material; 8, less skilled labor required. The field for electric arc welding is unlimited and the process has made enormous strides during the last few years. New fields for its successful application are being discovered every day.

Electrical and Mechanical Equipment for Ships is the subject of a catalogue which has just been published by the Horne Manufacturing Company, 2 College Place, Brooklyn, N. Y. The company announces that it will submit estimates for the installation of marine electrical equipment, complete ship telegraph systems, and the installation of voice tube systems.

Storage Tanks are described in Bulletins 79 ME and 88 ME, published by the Wayne Oil Tank & Pump Company, 589 Canal street, Fort Wayne, Ind. "The first cost of a tank is the least thing to consider. Once a tank is installed, especially underground, it will cost you as much as the price of the tank to take it up and repair any leakage that may occur. Tanks may hold water, even steam pressure, but gasoline and volatile liquids require special care in construction and carefully selected materials. Some tanks are built down to a low price, and once installed give and endless amount of trouble—more, in fact, than the added price of a quality tank—a Wayne tank. Wayne tanks for above or below ground storage are built to stand any service, and to efficiently, safely and continually render satisfaction. The price is determined solely by the cost of finest materials fashioned by picked mechanics. Every Wayne tank is built according to Underwriters' Rules and with the definite idea of making a permanent, satisfied customer of every owner."



SCALE—AND THE CURE

Boiler scale cannot be prevented from forming, but there is a way of removing it easily.

The answer is to use

DIXON'S PIONEER

BOILER GRAPHITE

It is introduced into the boiler feed water. The particles work their way through the minute fissures of the scale, lubricate the scale, so to speak, and greatly facilitate subsequent cleaning by ordinary methods. Once clean, scale cannot again burn fast to the metal.

Both time and labor costs are cut in half, and cleaner boilers are the result.

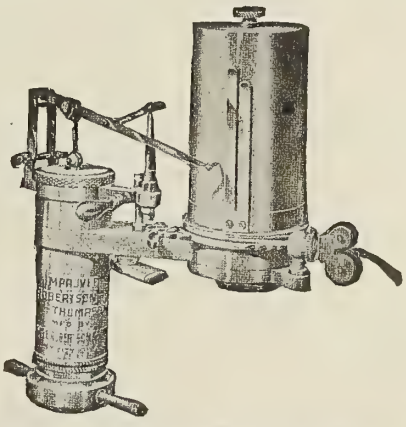
Graphite has not taste or odor, nor is it soluble. It does not prevent the use of live steam for cooking or washing. It does not destroy gaskets, valves and fittings on steam lines.

Write for Booklet No. 75-T and further information.

Made in JERSEY CITY, N. J., by the

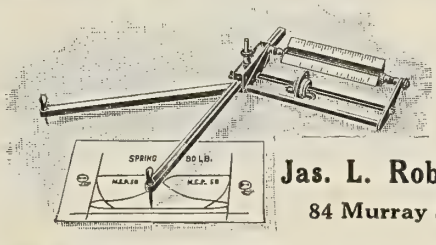
JOSEPH DIXON CRUCIBLE COMPANY

ESTABLISHED 1827



You can't feel your Engine "Pulse" without a good Indicator—Here's the Robertson-Thompson and the Willis Planimeter. THE A. B. C. WAY OF REALLY KNOWING to the absolutely accurate and direct figuring of diagrams. THEN YOU KNOW.

The prices for these instruments are lower than you ever thought of. Don't you want to know them?



Jas. L. Robertson & Sons

84 Murray St., New York

"Electric Arc Welding" is the title of Bulletin No. 700, which is issued by the United States Light & Heat Corporation, Niagara Falls, N. Y., and contains interesting information regarding the new aspects of the arc welding process which have developed in the war emergency. The bulletin also contains a detailed description of the apparatus supplied by this company.

"A Revolution in Rivets" is the title of a folder published by the American Flexible Bolt Company, 50 Church street, New York. "For a century no one thought of improving rivets. Indifferent workmanship was an easy explanation for unfilled holes and leaky rivets. Yet boiler makers knew the hole under the head was never tightly filled. In cutting out an ordinary rivet they always cut the head off and drove it out from the head end. This was because that end was always loose in the hole, and it was almost impossible to drive it out the other way. It was tight at one end only. 'American' rivets fill the hole under both heads. Both heads are formed while driving. Sufficient metal is provided to form perfect heads and tightly fill the hole. It avoids the need of calking."

A Testing Sample free is promised by the Central Steel & Wire Company, Department 43, 119 North Peoria street, Chicago, Ill. "Try these specialized welding rods and wire 'on us.' We'll furnish them free to you, paying all express or parcel post charges, too, a sample sufficient to let you prove for yourself our claim—that we have absolutely ascertained the correct analysis for every kind of welding job. Welders long have known that no one or two filler analyses would do for all work. It remained for Swedox to experiment and determine the right analysis for each special variety. Swedox welding fillers are products backed by scientific research—that of the best metallurgists in the country—and by practical every-day demonstration—by 90 percent of the nation's welders, big and small. There's a considerable advantage in using Swedox fillers. In the first place they are uniform in analysis and free from impurities. That means a lot, because it assures you of ideal results in your work, an assurance missing if you use fillers made according to haphazard, unscientific standards. And they're economical because their use reduces the cost of application and of machining. But mainly it's the specialization of Swedox products that makes them the logical up-to-date fillers. Thousands of welders know that, and there isn't a variety of welding job in which they haven't proved satisfactory. We want you to know it. Hence the free offer. Fill out the coupon, pin it to your letterhead and mail to us. In return we'll rush the special kind of filler you name —entirely, as we said before, at our expense from factory to you."

"The Advantages of the Hollow Bolt with the Durability of Ulster Special" are set forth in Joseph T. Ryerson & Son, Chicago, Ill., in a bulletin recently published. "Made from the original solid finished bar of identical Ulster Special that is standard for staybolts on majority of leading railroads—no change in process of its manufacture. Self-inspecting — hole perfectly round and true. Guaranteed not to split in threading or driving, which increases output and reduces shop cost. Will pass all railroad and other standard staybolt iron specifications. Furnished in lengths and sizes used, saves time and cost of cutting, eliminates crop ends and facilitates handling. Once tried the results will justify its continued use."

"The Truth About Galvanizing" is the title of a booklet just published by Wilcox, Crittenden & Company, Middletown, Conn. After a long description of the process of galvanizing the booklet goes on to say: "In order to operate a galvanizing plant to advantage it is essential that the kettles should be worked continuously. Idle kettles means a constant waste of zinc; if allowed to cool off when not in use, heating up is expensive and detrimental to the kettles themselves. Unless a manufacturer has sufficient work to insure continuous operation of his kettles, therefore, it will be found much more economical to have the work done by someone who is in position to specialize on galvanizing. With concerns so situated, we are in an exceptional position to co-operate to mutual advantage. Our facilities for galvanizing are such as are seldom found together in one plant, and enable us to handle such small articles as screws, tacks, washers, etc., or structural steel up to 40 feet in length. With unsurpassed equipment we combine a personnel of unusual capacity, developed through long years of experience in handling an extremely varied range of work. When in the market we should appreciate an opportunity to quote on your requirements. In addition to our galvanizing department we also operate our own brass and gray iron foundries, drop-forging plant, hot tinning department, and a splendidly equipped machine department. All of our departments are open to job work, and we present an opportunity for superior service in connection with the following: Galvanized dropped forgings, galvanized gray iron castings, tinned gray iron castings a specialty, all machined if desired. The advantage of having such work done at one plant—under one management—with one profit—must be apparent to every purchaser. Responsibility is fixed beyond question, and we in turn must insist upon rigid inspection in every department. The possibility of material below standard reaching a customer is accordingly very remote. We believe that the high quality of our output is admitted by all purchasers."

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AMERICA

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Navy Department, Washington, D. C.

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29 West 39th Street, New York.

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Naval Academy, Annapolis, Md.

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The Minories, Tower Hill, London.

FOR SALE
QUICK DELIVERY

Diesel Motor Cargo Vessel "CERRITO." Principal dimensions are as follows: Length 170', Breadth 25', Depth 16', Draft Loaded 10' 6". Speed when loaded 6 to 7 1-2 knots. Single Screw. Powered with a 240 B. H. P. "Nelseco" Heavy Marine Oil Engine.

Now in active trade in Gulf of Mexico Waters. Low operating cost and a money-maker.

For further information write

The New London Ship & Engine Co.
GROTON, CONN.

"Wire your ships against fire"

TRADE FDW SYSTEM MARK

AUTOMATIC FIRE ALARM

Fire Detecting Wire Co., Inc.
2 West 45th Street New York
Telephone 3526 Vanderbilt

Wanted—Shipyard Executive

Duties, general supervision with exception of office routine. None considered who had not received a salary in excess of $4000.00 a year prior to 1914. Reply with full record, giving details of education, shipyard experience, salary expected, etc.

Address, Box 516,
care of MARINE ENGINEERING.

Immediate Shipment of materials for the boiler maker is promised in a bulletin issued by the Bourne-Fuller Company, Cleveland, Ohio. Among the materials listed are: Boiler plate, boiler tubes, Climax boiler and tank rivets (½ to 1½ inches, all lengths; ½ to ¾ inch, cold made), blue annealed sheets, staybolt iron, flanged and dished boiler heads, channels, bars, beams, angles, hand punches, steel hoops, plate steel, sheared plates, sheet steel, steel shafting, tees, tool steels, etc.

Publication of "Autogenous Welding" Resumed.—The Davis-Bournonville Company, Jersey City, N. J., writes MARINE ENGINEERING as follows: "The publication of *Autogenous Welding*, which was suspended during the war, has been resumed, and a copy of the July number is enclosed herewith. You will note that this 'Victory Number' is largely devoted to the part played by oxy-acetylene welding and cutting in the war, especially our own end of the business. The acute need of welders led to the establishment of the Davis-Bournonville Institute, and this will be continued. *Autogenous Welding* will from time to time give its readers the news of the Institute's work and process. Also, it will deal similarly with our experimental and research department and the other activities of the Davis-Bournonville Company."

"Ulster Special" Staybolt Iron is described by Joseph T. Ryerson & Son, Chicago, Ill., in a catalogue just published. "Every bar of Ulster Special solid staybolt iron is as perfect for locomotive staybolt service when it leaves the mill as over ninety years' experience can make it—further heating or working cannot improve it. Ulster Special seamless hollow is produced from the solid finished bar without heating or working. This insures the same uniformity and lasting quality that has made Ulster Special standard for staybolt on the majority of leading railroads."

"3000 Holes Between Grindings at Top Speed" is the title of a circular published by the Clark Equipment Company, Buchanan, Mich. "Celfor drills are your solution for maximum production. They will not burn or fuse at the corners and retain a keen cutting edge the longest. A greater chip clearance, due to our special 'twisting' process, allows of more speed and cleaner cutting. Celfor drills are made with shanks one size larger than standard to insure against breakage and tang troubles. Celfor drills are noted for their durability. They are made from a forging of high-speed steel and 'twisted.' This forging and twisting process densifies and hardens the metals, and is the source of satisfaction in Celfor drills. Send for copy of 'Celfor Tools' No. 16."

"Falls Hollow Staybolt Iron" is the title of a circular issued by the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio. In this circular the company emphasizes the fact that its staybolt iron is rolled in both inside and outside, squeezing the intervening walls to a fine degree of elastic density and preserving the fibers, which in the ordinary method of drilling are mutilated by cutting into the heart of the bolt. This company has been manufacturing hollow and solid staybolt iron more than thirty-five years. It is made in sizes ranging from ⅞ inch to 2 inches O. D., and in various mill lengths, the hollow bars averaging 10 feet, while the solids range up to 22 feet. The law requires a tell-tale hole in the hollow bars of a 3/16-inch area, and to this dimension most of our hollow material is rolled. We also roll bars of the larger sizes, used especially in marine boilers, containing an orifice or hole up to ½ inch diameter. In addition to supplying the long random bars in the rough, we also have unsurpassed facilities for furnishing the individual finished stays, ready for application, in any desired length and square headed, threaded 12 or 10 threads to the inch as specified. Both 'Falls Hollow' and 'Falls Solid' have been standard practice with nearly 100 percent of the railroads of the United States. Certain large foreign railroads specify 'Falls Hollow' exclusively."

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Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Foreman Loftsman, with complete mold loft force open for position with live concern. Sixteen years experience. Capable of taking charge of fabrication and hull construction work. Wonderful opportunity for yard requiring complete mold loft organization. Addres *Wm. J. Eichelroth,* 424 Knickerbocker Ave., Brooklyn, N. Y.

Wanted — A High-Class Service Engineer who is familiar with marine boilers as well as service work. Prefer man well acquainted with marine field both in the construction and engineering end. Excellent opportunity for development. State salary expected and give record of last three positions held. Address *N. B. Herman,* Box 851, Detroit, Mich.

Assistant Loft Foreman desires change. Thorough experience in loft work and management. College education. Long practical experience in drafting room, fabricating shops, production department, and outside construction. Address *Box* 32, care of MARINE ENGINEERING.

Hull Draftsman, college education, four years' naval work, four years' private experience, both coasts. Two years squad chief, desires position with shipyard or allied line. Address *Box* 49, care of MARINE ENGINEERING.

Wanted—A Ship Draftsman at present employed by a steel shipbuilding company in the East, and having spare time available, will make tabulated ship calculations, plotted curves plan, displacement scale or furnish ship or yacht lines to companies or individuals. Charges reasonable. Address *Box* 23, care of MARINE ENGINEERING.

For Sale—Upright Marine Boiler carrying 100 lbs. pressure; marine steam engine, 10x12; condenser pump; boiler pump, etc.; all in A-1 condition. Reason for selling—changing from steam to gasoline. Inquire of *Frank Cooper,* 137 Water street, New Haven, Conn.

Wanted—Position as Chief of Mold Loft in a permanent yard. Have had fifteen years experience in both commerce and yacht construction. My experience has been general and I am a first-class loftsman and mechanic. Can give good references. Address *Loftsman,* care of MARINE ENGINEERING.

Wanted—Drafting at home by expert. Tugs, lighters, schooners, yachts—steel, wood or concrete. Engine installation, alterations, repairs; yard layouts. Joiner details. Terms, $1.50 an hour. *E. Carroll,* 245-A Utica avenue, Brooklyn, N. Y.

Mechanical Superintendent, with broad, practical shop and shipyard experience in building and installation work, wants position. At present have charge of installation and outfitting. Executive ability and thorough organizer. Address *Box* 36, care of MARINE ENGINEERING.

Civil Engineer, fifteen months' experience as ship draftsman, desires employment with shipbuilding firm. Address *Civil Engineer,* care of MARINE ENGINEERING.

Wanted—Five or six first-class experienced marine engine draftsmen and checkers. Address *Adams, Lovell, Burlingham, Inc.,* 90 West street, New York City.

For Sale — One 13-inch General Electric type P. C. thirteen, twenty-ampere, one hundred fifteen-volt direct-current searchlight, complete with rheostat, overhauled and in A-1 condition. Three 67-foot and three 75-foot cargo booms in good condition. Address *Freeport Sulphur Company,* Freeport, Tex.

High-Class Engine Designer Wanted, also draftsmen, tracers and designers for structural and mechanical work on boats, derricks, etc. Good salaries and permanent position to the right men. Address *Chief Engineer, The Dravo Contracting Company,* Engineering Works Department, Pittsburgh, Pa.

Oil Engine Drawings for sale in full sets of standard shop working drawings. For 5,000- and 9,000-ton steamers, four-cylinder, 24 by 36, 1,450 horsepower, by 96 sheets, $1,200; for tugs, four-cylinder, 18 by 27, $1,000, and four-cylinder, 16 by 24, $900. For yachts or as auxiliaries, steel column crosshead type, 10 by 12, $900; 6 by 8, $600; 4 by 5 trunk piston, $300. Address *Fuel Oil,* care of MARINE ENGINEERING.

Designing Engineer—Wanted immediately a Marine Designing Engineer for a responsible and permanent position. Good opportunity for right man. Must be able to take complete charge of specifying, designing and ordering material for steam vessels. Must have good education and experience. Location New York. Address *Box* 74, care of MARINE ENGINEERING.

Practical Marine Foreman and Engineer wishes connection with repair shop. Would act as foreman and invest $3,000 to $5,000. Locate anywhere. References. Address *Box* 66, care of MARINE ENGINEERING.

Shipbuilder, with 18 years' experience in leading yards and New York harbor work, seeks responsible position as designer or naval architect, or would act as consulting engineer to parties contemplating extension of present fleet. Address *Designer,* care of MARINE ENGINEERING.

Wanted—Several experienced mechanical draftsmen; preferably men who have had thorough experience in the designing of marine Diesel or steam engines of large sizes. State age, experience and salary expected; permanent position. Address *Electric Boat Company,* Groton, Conn.

Diesel Engineer — Wanted immediately for a responsible and permanent position a competent and experienced Diesel Engine Engineer. Must be able to take complete charge of Marine Diesel engineering and designing work. Location New York. Address *Box* 85, care of MARINE ENGINEERING.

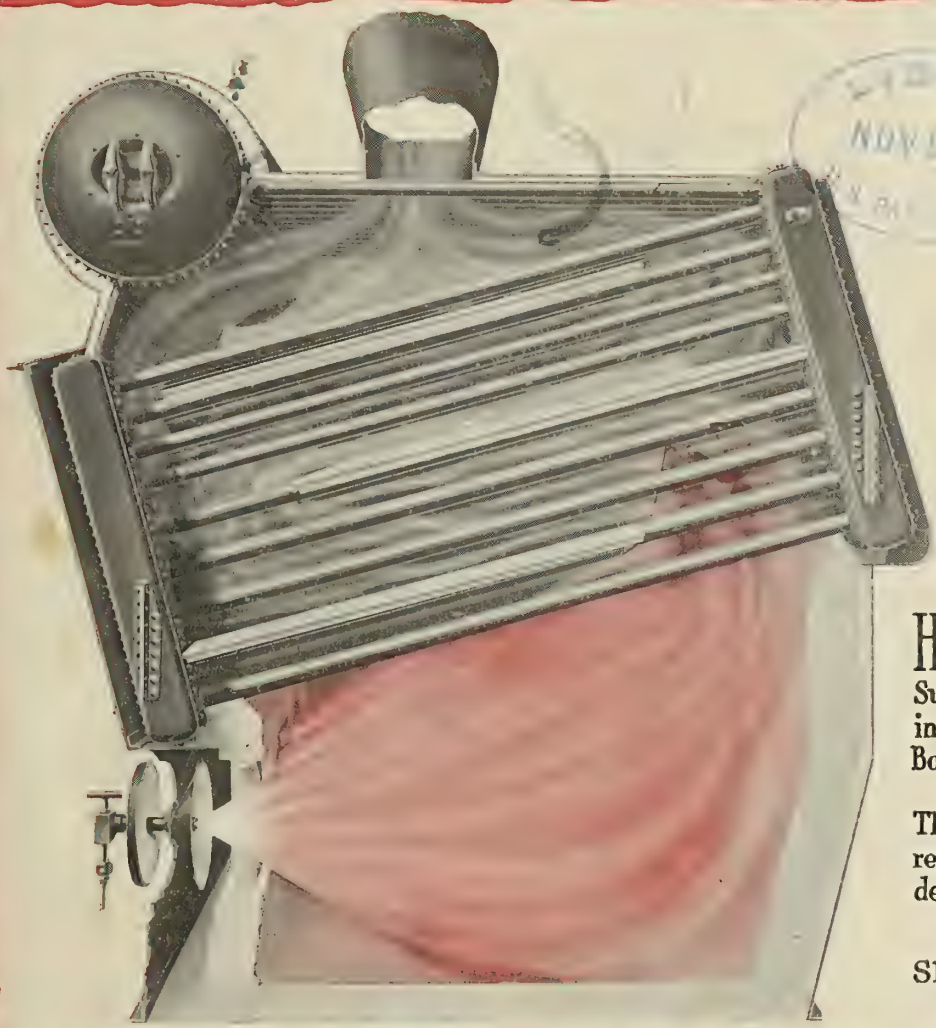
Designing and Detail Draftsmen—For permanent positions with large manufacturing concern in New England. Men with electrical, steam engine, turbine or special machine experience. Apply, giving age, experience, education and salary expected by addressing *Chief Draftsman, Box No.* 90-X, care of MARINE ENGINEERING.

Wanted — Technical Graduate familiar with Marine Engineering specifications, first-class marine engine, electrical and pipe draftsmen. Permanent positions for right men in shipyard near New York City. Address *Graduate,* care of MARINE ENGINEERING.

"Set Your Own Standard of Quality" is the title of a circular issued by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "And when you have, then carefully and critically examine the materials and workmanship used in the manufacture of the small tools made by us, you will find that these small tools reflect a perfect factory organization of skillful workmen and embody the very best materials possible to procure. In fact, the constantly increasing demand and our reputation, gained by thirty years' experience as manufacturers of dependable small tools, is assurance that the Cleveland Punch & Shear Works Company's small tools will 'make good' in actual performance. From an economical standpoint the Cleveland system of standardization punches should be of interest to you."

MARINE ENGINEERING

Main Office: NEW YORK 6 East 39th Street SUBSCRIPTION PRICE: Domestic, $2.00: Foreign, $3.00 LONDON OFFICE: 8 Bolverie St. E. C.



HELIOS

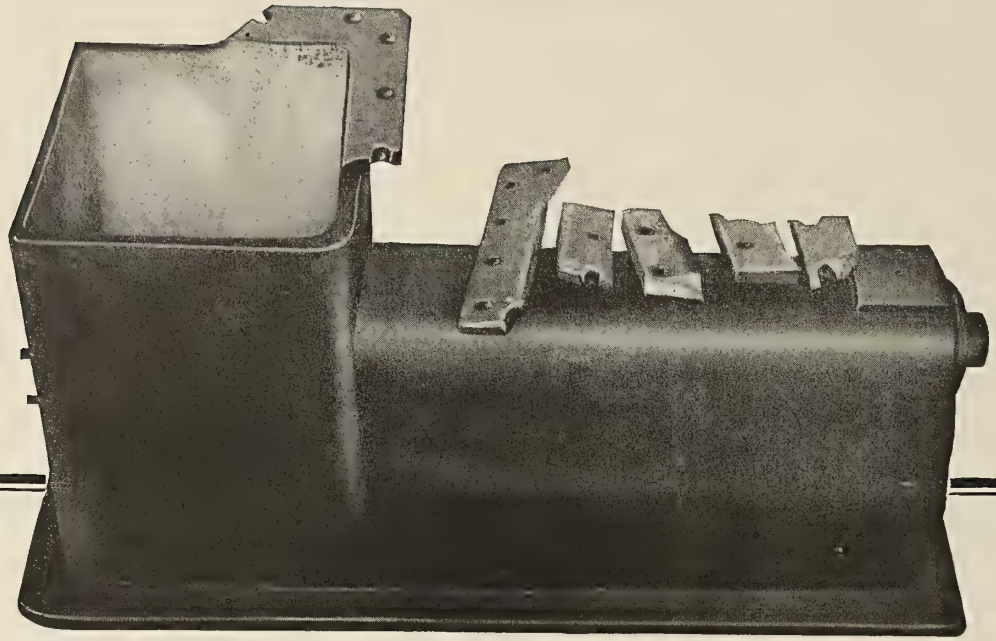
HEINE Marine Water-tube Boilers and Heine Marine Superheaters are described in our new treatise, "Marine Boiler Logic," just off the press.

This also gives valuable data regarding marine power plant design.

SEND FOR YOUR COPY

HEINE SAFETY BOILER CO.

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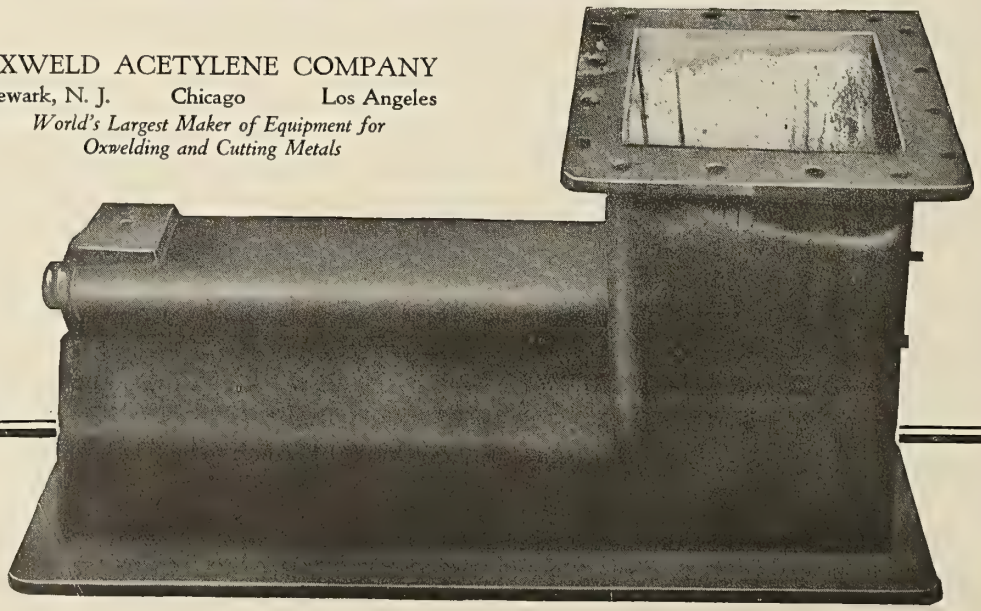


THIS big cast iron worm box broke in the flange, putting an important machine out of service.

And below is the same casting, practically as good as new after the pieces were reunited with the Oxweld Injector Type Blowpipe.....The net saving amounted to hundreds of dollars.

It is a waste to discard castings, forgings, machine parts—of whatever size or shape—because of breaks or worn surfaces. Oxweld them. Send for Bulletins showing examples of interest to *you* in connection with *your* plant.

OXWELD ACETYLENE COMPANY
Newark, N. J. Chicago Los Angeles
World's Largest Maker of Equipment for Oxwelding and Cutting Metals



181

Even Where Fuel Costs Nothing It pays to Use 85% Magnesia

THE Kaul Lumber Company's saw mill at Kaulton, Ala., is a model of modern industrial efficiency.

The 2,000 H P boiler not only provides the power for all mill operations but also furnishes an ample supply of steam for the drying kilns and other buildings.

As is the case with most lumber mills, so plentiful is the supply of wood fuel that a big incinerator runs day and night to burn up the waste of slabs, cuttings, sawdust, etc. which is not only valueless but a positive nuisance.

Yet despite the fact that this fuel costs them nothing, all of their steam pipes and boilers are protected with 85% Magnesia.

The reason is of course that the 85% Magnesia covering insures greater *efficiency*—that in place of a wet "soggy" vapor, their engines always have an ample supply of hot *dry steam*.

Where coal is scarce and dear, 85% Magnesia is also a marvellous fuel *saver*, but no matter what your fuel cost, whether high or low, you will find your operating conditions are always better, your steam supply always adequate, if you cover your pipes, boilers, flanges and fittings with this matchless heat insulation.

Write for the new Table of Actual Monthly Coal Saving in Dollars and Cents, prepared by the Mellon Institute of Industrial Research. To Engineers and Architects we will also send the Specification for the correct application of "85% Magnesia" coverings, compiled by the same institute.



MAGNESIA ASSOCIATION *of* AMERICA



721 Bulletin Bldg. Philadelphia Penna.

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TRADE PUBLICATIONS

"**Thacher Bronze Propellers**" is the title of a handsomely printed and illustrated pamphlet of 12 pages, published by the Thacher Propeller & Foundry Corporation, Albany, N. Y. "The moderate size semi-steel Thacher Patent Process Propeller Wheel shown in photograph has just come from the foundry and is being balanced preparatory to being bored and keyseated. It is accurate in every detail and requires no machining or chipping other than the bore and keyway for driving shaft. The tip of every blade is true to a circle equal to propeller diameter. The pitch of every blade is accurate and true with the pitch of the other three blades. The thickness of each blade at a given point on an arc corresponds by caliper measure with the thickness at a similarly located point on every other blade. There are no measurable variations in any blade. The wheel as cast is more acurate than the present machine-finished wheel and has the further strength advantage of retaining the casting skin."

The Waterbury Rope Hand Book is a profusely illustrated volume of 220 pages, published by the Waterbury Company, 63 Park Row, New York. This hand book explains the advantages of fibreclad construction and the rest of its 220 pages hold all other rope information you could wish for. "Waterbury fibreclad wire rope is a wire rope each strand of which is served with tarred Russian hemp marline. This fibre covering prevents the shaving and wear of the strands during flexing movements. The tarred marline covering also prevents the wire strand of rope from moisture or water, eliminating the possibility of rust and also preventing foreign matter working through to the wire strands. It is claimed for Waterbury fibreclad rope that it is as strong a manila rope, three times its size and that it weighs only half as much; that it is as flexible and as easily manipulated as manila rope and less cumbersome, that it won't rust because of the marine serving which retains the internal lubrication of the wire strands and that it will outwear either bare wire or manila rope under all ordinary conditions and so is more economical."

The Bowser Oil Storage Service is described in a folder published by S. F. Bowser & Co., Inc., Fort Wayne, Indiana. "We are the pioneers in the manufacture of improved oil handling devices and the original patentees and manufacturers of the famous Bowser self-measuring hand and power-driven pumps, large and small tanks, gasoline and oil storage and distributing systems, self-registering pipe line measures, oil filtering and circulating systems, dry cleaners' systems, etc. All goods fully guaranteed. Upon receiving the barrels of oil from the oil company, the oils are emptied by gravity into leakproof storage tanks, thereby eliminating loss of oil on account of leaky barrels. The Bowser oil gauge tells the approximate number of gallons contained in the tank, thereby checking up short barrels and invoice mistakes. The easy one-man Bowser method of emptying barrels with cradle, track and dash, drains the barrel absolutely, thereby eliminating the loss due to oil being left in the bottom of the barrel."

The "Liberty V" Ship Telegraph is described in a circular published by Chadburn (Ship) Telegraph Co., of America, Department L. V., 5th Avenue and Liberty St., Troy N. Y. "The newest and most efficient of all ship telegraphs—produced by American Labor working under modern ideal conditions—and at a cost to you of nearly 50 per cent less than an instrument of lower efficiency used to cost. We had the finest telegraph in existence (over 12,000 merchant ships carry it exclusively); to-day, thanks to American genius, we are in a position to offer this telegraph at a remarkably low price. Made in all sizes and for every purpose. We are now manufacturing unusually high class lines of binoculars, compasses, sextants and sounding machines at prices that will interest you. Remember that Chadburn quality is the leading feature of every product of this organization. Estimates furnished. Prompt deliveries."

Convenient Producing Plants

THE BACKBONE OF PREST-O-LITE SERVICE

NATION-WIDE Prest-O-Lite Service brings straight to the user's hands a single cylinder of highest temperature gas—or hundreds of cylinders—

Such a Service must have a backbone strong enough to carry the tremendous load of national demand, flexible enough to meet the ever-changing needs of any one of an army of users.



Buffalo, N. Y.—A new Prest-O-Lite charging plant.

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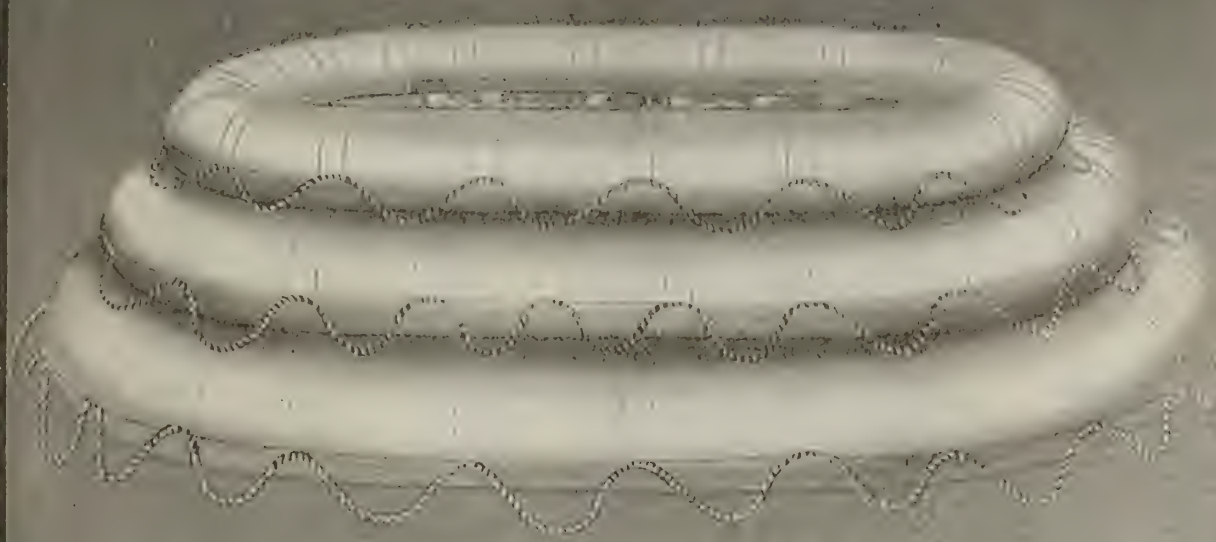
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Wherever you may be located, however large or small your requirements, there is an efficient Prest-O-Lite producing plant near—ready to serve you quickly and well.

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Mills' Releasing Gear
A. B. C. Life Rafts
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A. B. C. Ring Buoys
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Catalog on Request

AMERICAN BALSA COMPANY, Inc.

Welin Marine Dept. 50 E. 42nd Street, New York

London House: 5 Lloyds Avenue, London, E. C.

"**Manufacture and Advantages** of National Welding Scale-Free Pipe" is the subject of National bulletin No. 7, published by the National Tube Co., Frick Building, Pittsburgh, Pa. "When one considers that the introduction of wrought pipe dates back less than one hundred years; that the use was then confined almost entirely to gas and water; that today the varied uses and applications can scarcely be enumerated and the production runs into millions of tons—it must be acknowledged that wonderful progress has been made in the art of pipe manufacture. The past fifty years in particular have seen remarkable development in the wrought tubular industry, including the tonnage used, the capacity of mills, diversity of pipe service, and improvement of the material itself. During this period practically all improvements in wrought pipe manufacture have been confined to steel tubular products, and the result is that about 90 per cent of the wrought pipe used today is made of steel. The deserved popularity which steel pipe has attained is not the fruit of a haphazard program among pipe manufacturers. There has been no radical or spasmodic branching out by individual organizations in the effort to establish new fundamentals. The basic principles of the art have not been changed much if at all in the last thirty years; but the fact cannot be denied that wonderful improvements have been made in the industry and the product by modern application of the time-tried methods and processes. The same principles of steel making are recognized by all steel pipe manufacturers—all steel pipe is welded in practically the same manner—yet there are substantial differences in pipe. The factors which control the characteristics and properties, and thus produce these differences in various tubular materials, are the facilities of the manufacturer; the special processes supplementing the fundamental ones; the availability and quality of raw materials; the ideals and skill of the men in the organization—their capacity for genuine accomplishment. The career of National Tube Company is one that has been marked by a long series of accomplishments through which the steel tubular industry as a whole has benefitted substantially, and through which 'National' pipe has become a recognized standard among wrought tubular products."

The Klaxocator System for locating anyone of your important men in any part of your shipyard is described in a circular published by the Industrial Divsion of the Klaxon Company, Metropolitan Tower, New York, "It consists of the Klaxocator—placed near your telephone switchboard—and a number of electric signals so scattered in your plant that, when sounded, they are heard everywhere. The Klaxocator automatically operates these signals in such a manner as to sound various code numbers. Each of your important men is assigned a code number corresponding to a number on the Klaxocator dial. When a man is wanted the switchboard operator turns the dial to his number and pulls the lever. The proper signal is sounded at once in every part of the plant to tell him he is wanted. He lifts the nearest telephone receiver and is connected by the operator with the man who wants him. Your workmen need no longer be disturbed by messengers or by the switchboard operator with questions as to the whereabouts of this or that man. In any emergency there is no rushing about—no fussing—no waiting. With Klaxocator System in your shipyard your men are always instantly available. Our engineers will be glad to furnish plans and estimates on your requirements. Write to us today."

Dunn Stockless Anchors are described in a bulletin published by the American Steel Foundries, Chicago, Ill. "Security is the thing considered of most importance by all shipowners. Therefore a ship's anchors should not be neglected, for upon them security often depends. Should they fail to hold, should they foul, should they break—disaster is possible. Dunn Stockless anchors have proved their thorough reliability by years of unequaled service on every class of vessel. They lie snugly in the hawse pipe, ready to be let go. They eliminate all chance of fouling. And they have a holding power that is unfailing under all conditions."

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ARTHUR C. HARVEY CO.

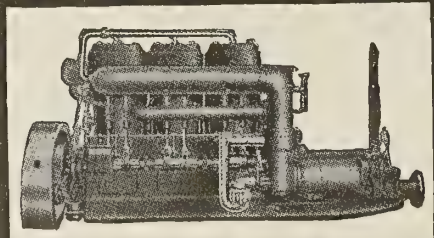
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BOILER TUBES, RIVETS, PLATES, TANK STEEL, FLOOR PLATES, BARS, SHEETS, STRUCTURAL SHAPES, COLD ROLLED SHAFTING.

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"The Motor With the Bore & Stroke"

PLUS FUEL COST REDUCED

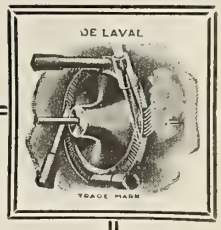
From 70 to 80 per cent without sacrificing reliability, flexibility or control. Perfect combustion on kerosene or lowest grade of Coast Distillate.

5 to 200 H. P. — 1 to 6 Cylinders

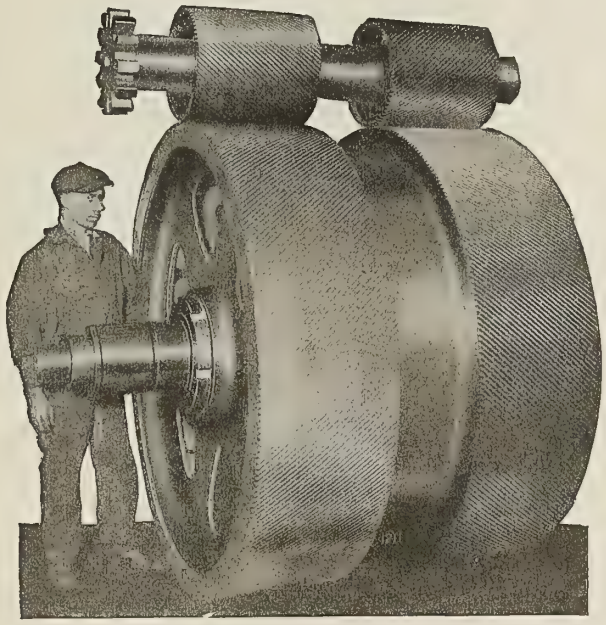
Ask for Catalog 73.

WOLVERINE MOTOR WORKS, Bridgeport, Conn.





A 100% RECORD



OVER one hundred De Laval Marine reduction gears ranging in capacity from 750 to 13,500 H. P. are in actual successful service, a number of which are installed in vessels which have each run over 100,000 miles.

THERE has not been a single case of trouble reported with any De Laval reduction gears, which, without exception, are characterized by their exceedingly quiet operation, high efficiency and absence of wear.

QUIET OPERATION

THIS record is the result of the many years of experience of the De Laval Company in the production of high grade, high speed reduction gears.

OUR record warrants the earnest consideration of ship owners and ship builders planning new construction.

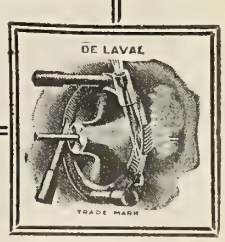
PROMPT shipment can now be made on geared turbine drives for all capacities and conditions of service, as the great demand of the Government for our products is practically over.

ASR FOR OUR CATALOG M 46

DE LAVAL STEAM TURBINE CO.

400 NOTTINGHAM WAY TRENTON, N. J.





"**What is Haskelite?**" is the title of a pamphlet published by the Haskelite Manufacturing Corporation, 133 West Washington St., Chicago, Ill. Haskelite is stated to be an ideal material for panelling on board ship and for similar purposes. The following is a partial description taken from the pamphlet. "Haskelite is an engineering material. It is the very first plywood ever produced with that idea in mind. It is designed with known engineering values. An engineering material has definite properties such as strength, elasticity and hardness that can be relied upon to such an extent that structural and other parts can be so designed from this material that their strength and other properties will be appropriate to the loads which the parts are expected to carry, or to the service which they are expected to give. Shingles are not used in design to carry particular loads; they are not structural parts and their material is not an engineering material. The rafters that support the roof are made sometimes of one size and sometimes of another, depending upon the loads that must be carried and upon the manner in which the rafters are supported. Rafters are structural parts, the material of rafters is an engineering material. Haskelite has definite properties of strength, elasticity, etc. Haskelite may be made up in various ways appropriate to different conditions. When we were in the midst of war preparations a designing table was issued to firms interested in airplane manufacture which showed 440 varieties of Haskelite appropriate for such work, and for each variety there were given the thickness, the weight per 100 sq. ft., and the strength in two directions."

Red Seal Kneadable Marine Metal Packing is described in a folder published by John Simmons Co., 102 Center St., New York. "Red Seal is a plastic metallic composition that is easily compressible into any type of stuffing box, gland, valve, cock, tap, etc., forming an impervious non-hardening metallic sleeve of absolute uniformity throughout. Red Seal is the most economical method of packing, as any fresh material will readily combine with the old into an homogeneous body. If desired, is easily and quickly withdrawn and every particle can be used again. It retains its qualities under any pressure, friction being reduced to a minimum. Red Seal by its very simple application, durability and imperviousness, assures the highest efficiency and utmost economy."

Self-Equalizing Expansion Joints are described in catalogue 18, just issued by E. B. Badger & Sons Co., 63 Pitts St., Boston, Mass. "Self-equalizing expansion joints distribute stress uniformly. This is an advantage that cannot be emphasized too strongly. The equalizing rings and lip on flanges limit the amount of compression on each corrugation, (first) insuring undue strain on any part, (second) high factor of safety, from standpoint of strength. Corrugations on joints 6 in. and over, 2¼ in. deep; corrugations on joints under 6 in., 1⅛ in. deep. There is no cracking, jamming or pipe distortion, because of the scientific design. There is no stuffing box or sliding member. Badger joints are dependable under all pressures."

"**Cross Drum Water Tube Boilers**" is the title of a 22-page illustrated catalogue published by E. Keeler Co., Williamsport, Pa. "The Keeler Water Tube Boiler is offered to discriminating steam users as the product of fifty-five years experience in constructing boilers of all standard types. Keeler quality is the result of a consistent effort to place Keeler boilers among purchasers who require the best that can be produced. To interest such purchasers we have met low price competition by producing an efficiency, that in a few years of service, will more than absorb the difference in the first cost. The character of the equipment shown in the following pages is partly the result of careful observation of each part or fixture in actual service. There is no feature of any boiler in the market today that is any more efficient or reliable than a similar feature of the Keeler water tube boiler. The extreme care used in the construction of these boilers can only be appreciated by a visit to our shop or by an inspection of the completed work. A thoroughly modern shop equipment, a progressive policy, and long experience enables the E. Keeler Company to meet the requirements of the most exacting specifications."

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INTERNATIONAL
COMPOSITIONS FOR IRON AND STEEL VESSELS' BOTTOMS
In use and in stock at all ports of the world. Over 18,000,000 gross tons of shipping coated annually
Proprietors of INTERNATIONAL COMPOSITION, ANTICORROSIVE, and ANTIFOULING
INTERNATIONAL COMPOSITIONS CO. Offices, Welles Bldg., 18 Broadway, N. Y.

VALK & MURDOCH COMPANY
CHARLESTON, S. C.
Builders of Marine Boilers, Scows and Lighters

8,000-Ton Floating Drydock		1,500-Ton Marine Ry.		500-Ton Marine Ry.	
Length on Blocks	440′	Length on Blocks	220′	Length on Blocks	100′
Depth over sill	22′	Depth over Blocks	14′	Depth over Blocks	7′

Marine Repairs a Specialty

STRATFORD SPECIAL NO. 1 MARINE OAKUM
receives the highest classification of the American Bureau of Shipping and Lloyd's Register of Shipping. It meets the requirements of all of the United States Government specifications. For years we have guaranteed the quality of each bale to be standard of excellence and returnable at our expense if otherwise. More of this grade Oakum has been used by the United States Government and its contractors than all other makes combined, yet, not a single bale has been condemned or rejected, whereas it has replaced the condemned Oakum of almost every other make. Our experience, quality and service are worth more to you than we ask.
GEORGE STRATFORD OAKUM COMPANY Jersey City, N. J.

Sun Marine Oils

HAVE PROVED THEIR WORTH

QUALITY SERVICE



RELIABILITY EFFICIENCY

Good Ships deserve Good Oils

Let our engineers solve
your engine room troubles

SUN COMPANY

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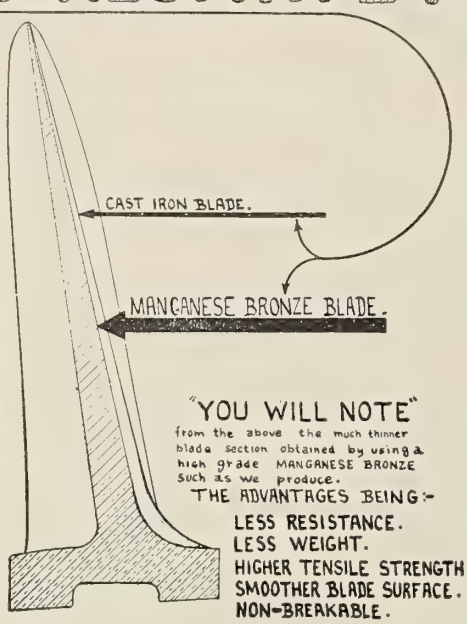
New York City Boston Philadelphia Baltimore Pittsburgh Cincinnati Buffalo St. Louis
Chicago Minneapolis Toledo Newark Newport News Detroit Atlanta New Orleans Sabine

An "Oil Fuel Installation" catalogue has just been published by Messrs. J. Samuel White & Co., Ltd., East Cowes, Isle of Wight, England. This is a handsomely illustrated booklet of 44 pages, from which we quote as follows: "Owing to the developments in the supplies of liquid fuel, the employment of same for steam raising for marine and industrial purposes is becoming of increasing importance. The advantages of liquid fuel for steam raising as compared with coal—or wood—are very great, and may be summarized as follows:—An increase in boiler efficiency, owing to the clean condition in which the boiler heating surface can be maintained, and the completeness of combustion obtainable with a good system of oil firing; high calorific value:—1 lb. of oil fuel averages 19,500 B. T. U. as compared with 12,500 B. T. U. for average coal. This is due to the inherent high calorific value of the hydrocarbon constituents and to the high purity of oils, the non-combustible matters usually being almost negligible; a constant and equal distribution of heat in the furnace, and as there are no fire doors to be opened, the cooling effect of a large volume of air passing over the furnace is avoided. Control of the air supply; a reduction in the cost of handling the fuel, as this can be done with a pump or pumps. A large reduction of stokehold staff, the number of firemen not being required as would be necessary for coal fired boilers. One man can regulate the burners of a considerable number of boilers; no wear and tear of grate bars; no dust, no ashes, and no clinker; when once arrangements have been made, the storage of oil fuel is simpler than the storage of coal, and oil does not deteriorate. One ton of oil averages 38 cubic feet to an average for coal of 43 cubic feet. The high calorific value and low stowage value enable a greater number of heat units to be carried or stored per cubic feet of space than for coal in the ratio of 1.7 to 1; the control of the steam production is easier, more effective, and more rapid than with solid fuels. Instantaneous ignition, and extinction of the fire; no smoke. The system herein described is that of pumping oil through the burners at a pressure of about 100 to 180 lbs. per square inch, and is recommended on account of its simplicity, higher efficiency, and greater applicability to high rates of evaporation, as compared with other systems. In this system there is no loss of fresh water, as is the case where steam is used as a spraying or atomizing agent."

Marine Boiler Logic.—The Heine Safety Boiler Co., St. Louis, Mo., has just completed the printing of "Marine Boiler Logic," a 69-page booklet dealwith the fundamental design of marine cargo carriers. The booklet was written by Chas. H. Stoddard, consulting marine engineer of the Heine company. The main part of the booklet relates to the design and construction of Scotch and water tube boilers for marine purposes. Evaporative capacities are worked out for the two types, using coal or oil as fuel, with natural or forced draft. The booklet contains also a discussion of power and speed of cargo vessels, formulas being developed showing the relation between boiler and prime mover capacity, and the dimensions of the hull. In making these computations, the method developed by Rear Admiral D. W. Taylor of the United States Navy, has been used, with certain modifications suggested by Mr. Stoddard's experience. The last part of the booklet is devoted to a description of the construction and operation of the cross-drum type of water tube boiler developed by the Heine company for marine service.

"Certainty" is the title of a bulletin issued by the Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., "Within the small compass of a bolt or nut there are factors which can make or mar the efficiency of a big machine. No assembly of metal parts has any security against accident, beyond that which lies in the integrity of its bolts and nuts. A flaw here can have disastrous consequences. You can afford no speculation, where efficiency is in the balance. Certainty is a necessary safeguard. There is nothing speculative about the quality of 'Empire' bolts and nuts. Their staunch virtues have become a world wide tradition, through 74 years of service in every conceivable line of industry.

"WHY HESITATE?"



MORAL.
If you want STRENGTH use Manganese Bronze . . .
If you want the STRONGEST, use . . . . .
S.M.B. Brand
. . . . . .

"YOU WILL NOTE"
from the above the much thinner blade section obtained by using a high grade MANGANESE BRONZE such as we produce.
THE ADVANTAGES BEING:-
LESS RESISTANCE.
LESS WEIGHT.
HIGHER TENSILE STRENGTH.
SMOOTHER BLADE SURFACE.
NON-BREAKABLE.

WE HAVE MADE
PROPELLERS
FOR MANY OF THE
LEADING SHIPYARDS

WE ARE EQUIPPED TO HANDLE THE LARGEST PROPELLERS DESIRED, AND ALSO TO SUBMIT PRICES ON

PROPELLER PATTERN MACHINING DESIGNING

AMERICAN MANGANESE BRONZE CO.
HOLMESBURG, PHILA., PA.
(*MANUFACTURERS OF SPARE'S BRONZES*)

When writing to advertiser, please mention INTERNATIONAL MARINE ENGINEERING.

New Jersey Zinc

The world's standard for Zinc products

ZINC PLATES

Our numerous mines yield such a comprehensive variety of zinc ores that we are able to exactly meet every zinc requirement.

Our rolling mills at Palmerton, Pa., are now prepared to furnish zinc ship plates and boiler plates of any desired dimensions and thicknesses and of just the right quality to best serve their purpose.

This organization with its extensive resources and its seventy years of experience in the development and production of zinc products, has unusual advantages in meeting the needs of the ship building industry.

THE NEW JERSEY ZINC COMPANY, *160 Front Street,* New York

ESTABLISHED 1848

CHICAGO: Mineral Point Zinc Company, 1111 Marquette Building

PITTSBURGH: The New Jersey Zinc Co. (of Pa.), 1439 Oliver Building

"**A Suggestion for the Chief Engineer**" is the title of an illustrated circular which has just been published by the Columbian Bronze Corporation, 50 Church Street, New York. "You have heard it said that bronze propellers eat away the stern frame of a steel ship. You probably are familiar with the reasons for such a statement, but in case you are not, the following may be of interest, particularly the portion which refers to the method of preventing action between bronze propellers and the stern frame. Whenever steel or iron and zinc (which constitutes about 40% of the metal known as Manganese bronze) come in close proximity to each other in a liquid, such as salt water or impure waters of any character containing light acids, sewage, etc., an electric battery is created, the action of which is known as galvanic action. This causes the zinc and the iron in very finely divided particles to detach themselves from their respective bodies, thus in time causing noticeable ruptures in the surface of the material. There is a definite point of distance between two such bodies of metal where this galvanic action ceases, and to prevent the action it is necessary to separate the metals by a greater distance than the minimum referred to. Practically the entire damage that might occur to the stern frame of a bronze propellered ship occurs when the ship is lying in port and in waters that are decidedly acidulous in their composition. In an attempt to overcome this action, zinc plates are many times fastened on the stern frame, and by such an installation of zinc plates the zinc in the bronze is not acted upon nor is the steel in the stern frame. A better way, however, to reduce this action, is to separate the bronze blades from the stern frame by stopping the shaft so that the blades will be in a position indicated in the above photograph. We suggest that you mark your shaft in such a way that when it is registered with any stationary point you may select, the blades are in the position shown, and that whenever you are in port you make it a rule to invariably rest your engine in this position. This will practically eliminate the galvanic action referred to and give greater life to the ship."

Plastic Arc Welding a Steamboat Cast Iron Cylinder. A description of how this is done without dismantling, pre-heating, annealing, etc., is given in a circular published by the Wilson Welder & Metals Co., 2 Rector St., New York. "The Plastic Arc method produces a mechanically sound weld, having the strength and ducility necessary to withstand severe strains to which important ship parts are subjected, at a lower cost than other methods or systems of welding. The Wilson plastic arc welder is particularly adapted for heavy repair work, also boiler plate, cast steel, cast iron, copper, brass and aluminum, etc. Cast iron can be successfully welded without showing a line of demarcation between the original and the added metal."

Buffalo Double Suction Impeller Multistage Centrifugal Pumps are described in bulletin 952A, published by the Buffalo Steam Pump Co., Buffalo, N. Y. The Buffalo "Class R. D. S." multistage pump is stated to be ideal for boiler feeding as it has a very flat horsepower characteristic and maintains high efficiencies over a wide range of capacities and boiler horsepowers. These pumps are built with capacities up to two thousand gallons per minute and pressures as high as four hundred pounds. "Buffalo Class R. D. S." multistage double suction impeller centrifugal pumps are a special development of all the best features in pump design, selected during our long experience as pump manufacturers, and are designed and built to meet the requirements of the most exacting service. These pumps are being used by large manufacturing concerns, public service corporations, city water works, and the United States Government. We particularly commend their investigation by discriminating engineers and users requiring pumps for public water supply, municipal and private fire service, boiler feeding, mill and factory water supply, or any other service where thorough reliability and high efficiency are important considerations."

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JEFFERY'S MARINE GLUE
In all the various grades it is the best for the money—the most serviceable. Pound for pound it will go further and do a better and a more lasting job than any other make. Do not be deceived by cheap imitations; see that the trade mark is on every package.
Send for booklets: "MARINE GLUE—WHAT TO USE AND HOW TO USE IT" and "HOW TO MAKE YOUR BOAT LEAK PROOF"
L. W. FERDINAND & CO.
152 Kneeland St. Boston, Mass., U. S. A.

UNION DRY DOCK & REPAIR CO.
Vessel Repairs in Wood and Iron
WEEHAWKEN, N. J.
Dry Docks and Shipyard Adjoining West Shore Ferry
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Fire Department Supplies
ANDREW J. MORSE & SON
INCORPORATED
221 HIGH ST., BOSTON, MASS.
DIVING APPARATUS


FOR SALE

Triple Expansion Marine Engine 18" x 32" x 54"—42" stroke. Has been in service fifteen lake seasons in a wooden steamer of 3000 tons capacity. Has been thoroughly overhauled and is in A-1 condition. Shipping weight approximately 70 tons.

Windlass, 8 x 10 of Providence manufacture, suitable for 1¾" stud link chain. Arranged for capstan drive. In first class condition.

Both subject to inspection. Immediate delivery.

McDougall-Duluth Company
Duluth, Minn.

"The Buda-Ross Electric Light Plant" is the title of a booklet issued by the Buda Company, Railway Exchange Building, Chicago, Ill., manufacturer of the Buda motor and supplies for mill, mine, and railroad. The booklet referred to shows the one kilowatt and the one-half kilowatt steam turbo-generator electric light plant manufactured by the Buda Company for lighting small industrial plants using a steam boiler, small steam boats, dredge boats, steam shovels, well drilling rigs, small mines, small saw mills, cotton gins, and any other industry using a steam boiler where the lighting requirements do not run over one kilowatt. The plant is an unusually small one for a steam turbo-generator plant, the smaller size having a capacity of one-half kilowatt and the larger size one kilowatt, making it adaptable for lighting small plants and portable outfits. The steam turbine and the electrical generator are built compactly into one unit. The speed is controlled by an automatic governor and the field coils of the generator have a compound winding which keeps the voltage uniform, on any lamp load ranging from zero to the full capacity of the plant. This makes the operation of the lighting plant entirely automatic, requiring no other attention than turning on the steam when the lights are needed and turning off the steam when lights are no longer needed. The Buda company began manufacturing small steam turbo-generators for locomotive headlight service about six years ago. The use of the small steam turbo-generator has grown into many industries and the demand for this kind of a lighting plant has grown to such an extent that the manufacturers have made some recent improvements in it, enlarged the facilities for production, and will market it generally thru dealers as one of the main line of Buda products.

"Marine Boiler Logic" is the title of a 56-page profusely illustrated catalogue published by the Heine Safety Boiler Co., 5322 Marcus Ave., St. Louis, Mo., "This book is issued for the purpose of calling to the attention of marine people generally the fact that the Heine Safety Boiler Company has definitely entered the marine boiler field. Inasmuch as the problems which have arisen in the past few years and which are even now paramount, are almost exclusively connected with cargo carriers, the technical discussions herein are confined to ships of this class, but the boilers are not, of course, limited to use in such boats. They may be used in any and every sort of steam propelled vessel. The Great War has been the cause of bringing into existence many new shipbuilding yards throughout the United States and this has presented opportunities for many young men to assume responsibilities of an engineering nature. For these men and for ambitious craftsmen everywhere, whose sights are upon something higher than the jobs they hold, this publication in intended. That it may be of real value to those men is our wish. That it may be of interest to others is our hope."

"Nickel and Its Products" is the title of a neat booklet published by the International Nickel Co., 43 Exchange Place, New York. The purpose is to convey to buyers in a concise manner a description of the company's nickel products and it is intended to serve as a guide when forwarding inquiries or when soliciting information about nickel. The pamphlet contains a brief history of the nickel industry in America. "The International Nickel Company maintains a well organized technical staff and is equipped with laboratories and facilities for testing and research work. This Department stands ready at anytime to give the benefit of its knowledge and experience and to co-operate in solving any problems relating to the properties and uses of nickel and its products."

Rome Hollow Staybolt Iron is described in a circular issued by the Rome Iron Mills, Inc., 30 Church street, New York. "Rome Hollow is an iron that is made hollow at the right time—when the iron is made. Bars are rolled to standard length—12 to 16 feet. You make your own staybolts for each job in the old economical way. Rome Hollow is rolled by the Jenkins patented process. The same men, the same mill, give it the Rome superior quality you've known for fifty years. And remember, every bar is guaranteed."



SCALE—AND THE CURE

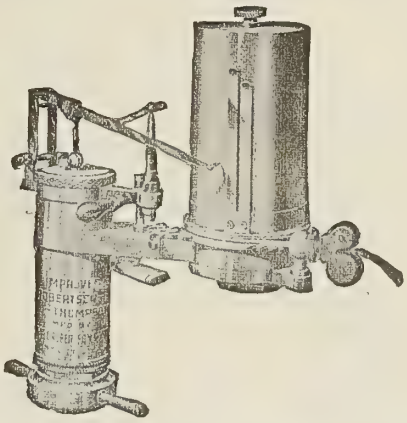
Boiler scale cannot be prevented from forming, but there is a way of removing it easily.
The answer is to use

Dixon's Pioneer
BOILER GRAPHITE

It is introduced into the boiler feed water. The particles work their way through the minute fissures of the scale, lubricate the scale, so to speak, and greatly facilitate subsequent cleaning by ordinary methods. Once clean, scale cannot again burn fast to the metal.
Both time and labor costs are cut in half, and cleaner boilers are the result.
Graphite has not taste or odor, nor is it soluble. It does not prevent the use of live steam for cooking or washing. It does not destroy gaskets, valves and fittings on steam lines.

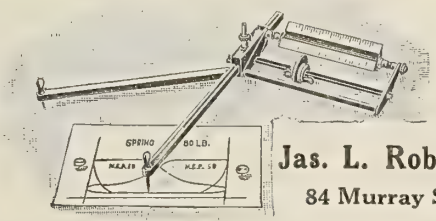
Write for Booklet No. 75-T and further information.
Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE CO.
ESTABLISHED 1827



You can't feel your Engine "Pulse" without a good Indicator—Here's the Robertson-Thompson and the Willis Planimeter. THE A. B. C. WAY OF REALLY KNOWING to the absolutely accurate and direct figuring of diagrams. THEN YOU KNOW.

The prices for these instruments are lower than you ever thought of. Don't you want to know them?



Jas. L. Robertson & Sons
84 Murray St., New York

The De Laval Oil Purifier is described in Bulletins No. 102 and 103, issued by the De Laval Separator Co., 165 Broadway, New York. "The De Laval centrifugal oil purifier is simple in construction and operation. This simplicity means long life and freedom from repairs, and is the outcome of over forty years of unquestioned leadership in the manufacture of centrifugal machines. The De Laval oil purifier is the simplest and, at the same time, the most effective means of eliminating grit, dirt, carbon, water and other impurities from crank case and other lubricating oils, instantly restoring them to original usefulness. The oil purifier is built in three sizes, and with electric, belt or direct steam turbine drive. It occupies less than two square feet of space and uses very little power."

Chadburn Ship Telegraphs are the subject of a catalogue published by the Chadburn (Ship) Telegraph Company of America, Troy, N. Y. "The company's plant at Troy, N. Y., is manufacturing all ship telegraph material, engine counters, speed indicators, etc., for the mercantile service, the same as the works in Liverpool, England. We also have a Navy Department manufacturing special instruments for the United States Navy identical with the material manufactured by the Liverpool plant for the British Admiralty. The completeness and location of our factory assures prompt deliveries.

The Wilson Plastic-Arc Welder for use in shipyards and on board ship is described and illustrated in a circular just issued by the Wilson Welder & Metals Company, Inc., 10 Rector street, New York. "The splendid success of the Wilson Plastic-Arc welder in the repair of the German ships has started a general discussion of the advisability and practicability of adopting this method of welding for manufacturing purposes. A special meeting of the technical committee of Lloyd's Register of Shipping was recently held in London to consider this subject in connection with shipbuilding to the extent of eliminating by this method the use of rivets for important structural connections. The Wilson Plastic-Arc welder is as well adapted to manufacturing purposes as it is to repair work. It is very economical in operation, can be used to good advantage in the welding of metal parts of any character. It is also, of course, a ready-repair tool in the case of breakage or damage to cast iron cylinders, valve chests, pipe lines, engine bases and parts. Successful welds can be made in the open or in cramped, confined spaces—anywhere a man and a wire can go. All successful welding depends upon a constant uniform temperature at the weld. The more nearly constant the heat the better the weld. A steady, uniform, predetermined heat is always automatically maintained in Wilson Plastic-Arc welding."

Air Compressors are described in Bulletin No. 3230, just issued by the Ingersoll-Rand Company, 11 Broadway, New York. "There's a little something that enters into the building of an Ingersoll-Rand class 'ER' or 'FR' compressor that makes these small units stand out as superior in the test of racking, constant service. It gives them a distinct place in the field of small machines, make them the first choice when it comes to the selection of an air compressor to fill a place of responsibility. Not only reliable, but also economical. Efficient design minimizes the power requirement and automatic features keep down the need of attendance. When you need a good, small air compressor investigate the Ingersoll-Rand machines."

"Thor" Universal Electric Drills are described in a bulletin just published by the Independent Pneumatic Tool Company 600 West Jackson Boulevard, Chicago, Ill. "Indispensable for all kinds of drilling, reaming and wood boring in the building of automobiles, steel and wood cars, boilers, auto bodies, and in railroad and structural shops, ship and drydock work and machinery repairs. The super-power motor is designed especially for the Thor drill, and posses certain distinctive features resulting in extra power. It is absolutely impossible to stall a Thor drill on any work up to its full rated capacity. They will develop greater power than other drills weighing several pounds more. An aluminum crank case on the small sizes insures lightness and convenience in handling and operating. The Thor is the only portable electric drill made with ball and roller bearings throughout, reducing friction to a minimum and increasing the efficiency."

Automatic Sprinkler Protection on Shipboard is the subject of a special bulletin published by the Marine Department of the General Fire Extinguisher Company, Providence, R. I. "Automatic sprinkler protection has never been largely installed on shipboard, because of certain vital objections raised by shipowners and naval architects. A new type of system, however, has been designed by our engineers which seems to meet all previous objections to this type of protection. This new system is dry pipe, and is still automatic. Water cannot be discharged on account of any accident to the piping system or the sprinkler heads. But water is instantly discharged in case of fire without any human aid. This new type of system makes a great advance in the art of automatic fire protection aboard ship. The type of fire protection that has reduced factory fire risks to practically nothing is now available to the shipowner. Send for our special bulletin giving greater details to this system. We are glad to submit plans, estimates and proposals without cost or obligation."

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.

NATIONAL ASSOCIATION OF MASTERS, MATES AND PILOTS
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5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

Benjamin Marine Lighting and Sixnaling Apparatus is the subject of a catalogue just published by the Benjamin Electric Manufacturing Company, Chicago, Ill. "In this catalogue are illustrated and described the Benjamin marine lighting and signaling apparatus which are in general use in the shipbuilding industry. The wide experience of Benjamin engineers in laying out and manufacturing electric lighting and signaling apparatus has been recognized by both the engineers and builders in charge of America's ship construction. In the Benjamin line all parts are standardized to the highest point in order that the utmost interchangeability may be possible. Junction boxes may be installed and the receptacles, connecting blocks, or switches, and covers may be mounted later, as the locations require. The same applies to fixtures. In them all parts are interchangeable. Such flexibility insures ease and speed of installation, convenience and protection in purchasing and absence of trouble when the ship is in service. To meet the demand for an insulation of a superior mechanical strength and insulating quality, current carrying parts of Benjamin marine fittings are mounted on bases of high heat molded insulating material. Both interchangeability and improved insulation are but one of a number of features contributing to Benjamin superiority, and are mentioned here because they are the two developments unanimously urged by shipbuilding engineers."

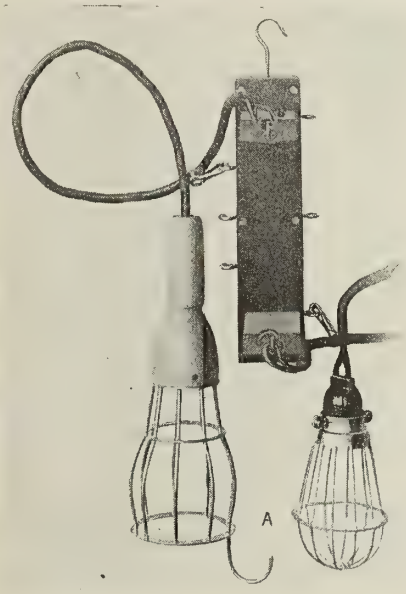
The "Universal" Ladder Step, designed for use on shipboard, is designed in a circular published by the Universal Safety Tread Company, 40 Court street, Botson, Mass. "This ladder step is designed for use on shipboard for all types of naval and merchant vessels wherever an all-metal self-supporting safety tread step, suitably reinforced, is required, as well as for industrial purposes, power house or engine room stairs, and all other similar situations. It combines four most essential features—non-slip efficiency, strength and stiffness, light weight and rust-proof advantages."

Blackmer Marine Pumps are described and illustrated in a catalogue and price list published by the Blackmer Rotary Pump Co., Book Building, Detroit, Mich. "Day and night—three hundred and sixty-five days a year is the schedule of Blackmer marine pumps. Even the severity of salt water and bilge service does not make them falter. Silent yet always ready to perform efficiently. As an element of safety in case of fire they have no equal. The operation of Blackmer rotary pumps creating centrifugal force control the position of the buckets. These buckets thus take up natural wear by swinging further out. Blackmer marine pumps have removable linings of semisteel or hard bronze. New linings can be obtained for a nominal sum and installed quickly and easily without special tools or skilled workmen. Properly installed pumps need no priming. Blackmer rotary pumps are made in all sizes from 1 to 500 gallons per minute."

Dependable Deck Machinery is described by the American Clay Machinery Company, Bucyrus, Ohio, in a catalogue recently published. "This is a dependable line of deck machinery, especially designed to meet exacting Government requirements and built to pass rigid Government inspection. This line is 'Built Right and Runs Right.' So satisfactory was it in design and construction that the largest sales ever made of this class of equipment were sold for Government ships. Each machine is built in quantities on the interchangeable part plan, and prompt shipments are possible. The line includes winches, captans, steering engines, windlasses, etc.

Hanna Riveters are described and illustrated in a catalogue published by the Vulcan Engineering Sales Company, 1755 Elston avenue, Chicago, Ill. "Is the portable riveter you are going to buy designed with an eye toward the convenience of the operator, or is it cumbersome as to hamper and hinder his movements Hanna riveters are made in many types and sizes, but in all of them the same fundamental principles have been retained. They are the result of careful study of actual operating conditions. Used in practically all shipbuilding plants throughout the country. Write for catalogue, which illustrates and describes these machines."

"LITEHOLD" Portable Strip and Plugs



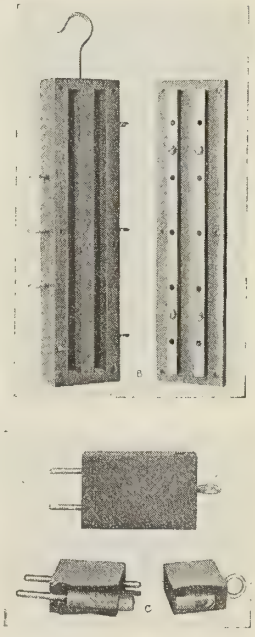
For temporarily lighting Hulls of Ships under construction

Illustration A.—Strip and 2 Plugs showing different type guards.

"B" carbolineum treated maple base with fibre top and brass connections for 5 plugs, Base 10½ in long, 2½ in. wide 1 13/16 in. thick.

"C" hard rubber plug, 1-in. thick 2-in. wide, 3⅛-in. long, with brass prong contacts and midget enclosed fuse. Fuses 2 to 15 amp. as desired. Note supporting hook, also snap hook strain relief for plugs.

OKONITE hard service cord recommended for use with above.



NOVELTY ELECTRIC COMPANY

Manufacturers and Distributors Electrical Supplies
50-52-54 North Fourth Street, Philadelphia
Agents for
Okonite—Wireless Cables—Tapes Holtzer-Cabot—Motors—Generators, Etc.

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☞ *No advertisement accepted unless cash accompanies the order.*

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired and they will be forwarded without additional charge.

Wanted At Once—Two first class hull draftsmen. Apply *H. O. Trowbridge*, Naval Architect, Groton Iron Works, Groton, Conn.

Chief Engineer Wanted—Familiar with marine gas engine and propeller design. Good Salary. Address *The Engineering Agency, Inc.*, 1662 Monadnock Block, Chicago, Ill.

Wanted—One copy each of (International) MARINE ENGINEERING for the months of January 1918 to July 1918, inclusive. Address *Box 3*, care of MARINE ENGINEERING.

Wanted—A Marine Auxiliary Draftsman, capable of designing steering engines. Permanent position. Give age, experience, education and salary expected. *The Maine Electric Company*, 35 Commercial Street, Portland, Maine.

Marine Engineer—Wanted for an important and permanent position a high-grade marine engineer to take full charge of work. Excellent opportunity. Large Company. Location New York. Address *Box 28*, care of MARINE ENGINEERING.

Position Open—For Assistant Naval Architect with oil company. Requires practical experience, especially with tankship construction; also, good working knowledge of marine engineering. Address "*Tanker*" care of MARINE ENGINEERING.

Draftsman—Experienced in Marine Machinery drawing offices as designer and checker, and also in marine engine workshops, with steam and gas engineering education, will be free to take new place soon. Address *Box 4*, care of MARINE ENGINEERING.

Practical Marine Foreman and Engineer wishes connection with repair shop. Would act as foreman and invest $3,000 to $5,000. Locate anywhere. References. Address *Box 66*, care of MARINE ENGINEERING.

Marine Salesman desires representation with the manufacturer or distributor of engine and boiler room supplies or auxiliaries. Applicant is thoroughly conversant on above, having had seven years practical experience in the operation of reciprocating and turbine and reduction gear drives and fuel oil systems, holds unlimited tonnage ocean license. An opportunity to convince you will be appreciated. Address *Box 405*, care of MARINE ENGINEERING.

Wanted: First-Class Marine Engine Draftsman—For shipyard in the New York district, building nine thousand ton ships. Answer in full regarding age, experience and salary expected. Address *Marine Engine Draftsman*, care of MARINE ENGINEERING.

Wanted—Technical Graduate familiar with Marine Engineering specifications, first-class marine engine, electrical and pipe draftsmen. Permanent positions for right men in shipyard near New York City. Address *Graduate*, care of MARINE ENGINEERING.

Wanted—Drafting at home by expert. Tugs, lighters, schooners, yachts —steel, wood or concrete. Engine installation, alterations, repairs; yard layouts. Joiner details. Terms, $1.50 an hour. *E. Carroll*, 245-A Utica avenue, Brooklyn, N. Y.

Shipbuilder, with 18 years' experience in leading yards and New York harbor work, seeks responsible position as designer or naval architect, or would act as consulting engineer to parties contemplating extension of present fleet. Address *Designer*, care of MARINE ENGINEERING.

Mechanical Superintendent, with broad, practical shop and shipyard experience in building and installation work, wants position. At present have charge of installation and outfitting. Executive ability and thorough organizer. Address *Box 36*, care of MARINE ENGINEERING.

Wanted—Several experienced mechanical draftsmen; preferably men who have had thorough experience in the designing of marine Diesel or steam engines of large sizes. State age, experience and salary expected; permanent position. Address *Electric Boat Company*, Groton, Conn.

For Sale—One 13-inch General Electric type P. C. thirteen, twenty-ampere, one hundred fifteen-volt direct-current searchlight, complete with rheostat, overhauled and in A-1 condition. Three 67-foot and three 75-foot cargo booms in good condition. Address *Freeport Sulphur Company*, Freeport, Tex.

Purchasing Agent—A steel shipyard located in North Atlantic district has a vacancy for a thoroughly experienced and competent purchasing agent. None but experienced men who are capable of properly organizing and running a purchasing department will be considered. Applications, which will be treated in strict confidence, must give names of not less than three business references and names of firms in which recent experience has been gained and positions held, must state also age, whether married or single and salary expected. Address *Purchasing Agent*, care of MARINE ENGINEERING.

High-Class Engine Designer Wanted, also draftsmen, tracers and designers for structural and mechanical work on boats, derricks, etc. Good salaries and permanent position to the right men. Address *Chief Engineer, The Dravo Contracting Company*, Engineering Works Department, Pittsburgh, Pa.

Designing and Detail Draftsmen—For permanent positions with large manufacturing concern in New England. Men with electrical, steam engine, turbine or special machine experience. Apply, giving age, experience, education and salary expected by addressing *Chief Draftsman, Box No. 90-X*, care of MARINE ENGINEERING.

Oil Engine Drawings for sale in full sets of standard shop working drawings. For 5,000- and 9,000-ton steamers, four-cylinder, 24 by 36, 1,450 horsepower, by 96 sheets, $1,200; for tugs, four-cylinder, 18 by 27, $1,000, and four-cylinder, 16 by 24, $900. For yachts or as auxiliaries, steel column crosshead type, 10 by 12, $900; 6 by 8, $600; 4 by 5 trunk piston, $300. Address *Fuel Oil*, care of MARINE ENGINEERING.

Ship Draftsman—Wanted to design and superintend the building of a small steel vessel, about 400 tons. Must have thorough knowledge of small ship designing and high class steel construction. Capable of specifying and obtaining bids, and inspecting work whilst in progress. Temporary help only: traveling expenses paid. Reply stating experience and salary required out of New York. Address *Shipowner*, care of Abbott, Masonic Buildings, Nassau, N. P., Bahamas.

A North Atlantic Shipyard building steel vessels has an opening for a technically trained and thoroughly experienced man to act as technical assistant to head executive. The man appointed must be capable of preparing estimates for new and repair work, write specifications, and look after claims against owners for extras and delay. Application, which will be treated with confidence must in first instance give full and detailed particulars of training and experience. Address *Box 749*, care of MARINE ENGINEERING.

"**Penberthy Boiler Room Necessities**" is the title of an 18-page booklet published by the Penberthy Injector Co., Detroit, Mich., among which are the following: "Penberthy automatic injectors, auto positive injectors, 'XL-96' ejectors, ejectors for all special requirements, regrinding valves, automatic and non-automatic cellar drainers, oil cups, grease cups, automatic and non-automatic water gages, plain engine lubricators, hand oil pumps, dripless air cocks, noiseless water heaters, etc."

INTERNATIONAL

MARINE ENGINEERING

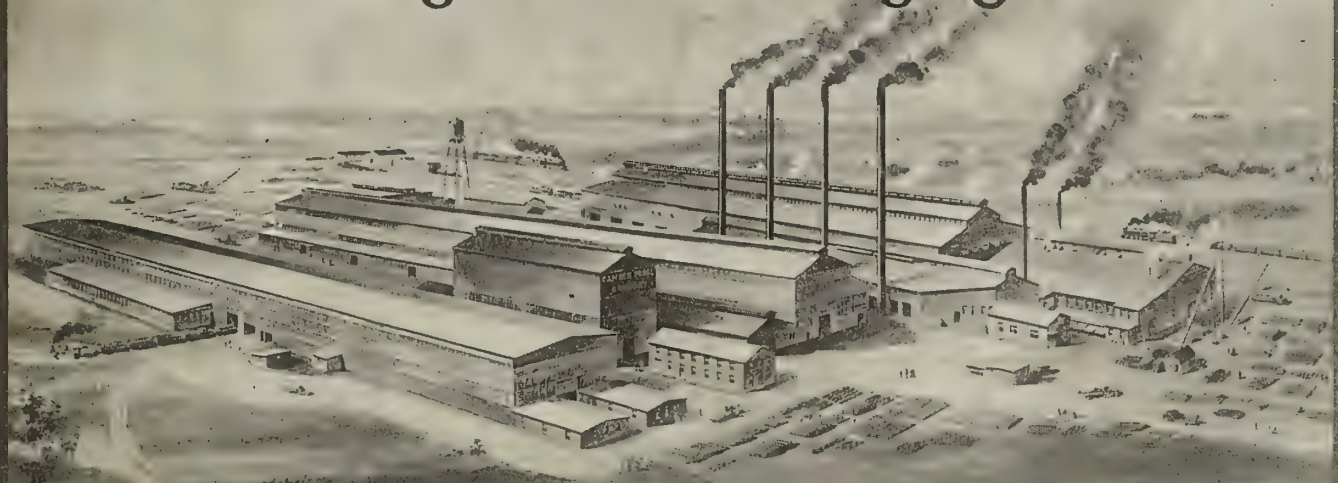
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When the staunch American liner "St. Paul" sank in New York harbor just before she was to sail for France, it took four months to raise her and to pump the mud and water from her engine rooms and holds. Then it was discovered that the only equipment of her boilers and pipes that was wholly free from damage **was their heat-insulating coverings of "85% Magnesia".**

A quarter of a century of continuous, exacting service had not impaired in the least the heat-saving efficiency of these "85% Magnesia" coverings. **Nor had four months of continuous soaking at the bottom of the harbor impaired them in any way.**

No more strenuous test of the durability and unimpaired efficiency of any heat-insulation was ever made.

Those two outstanding properties of "85% Magnesia" — DURABILITY and EFFICIENCY—have made it the standard heat-insulation wherever the highest standards of service are required.

Where You Find It

The U. S. Navy has specified "85% Magnesia" for its Fleet since 1888, and the U. S. Shipping Board followed suit. The greatest steamships and strongest tugs are protected by it. Our powerful locomotives are "lagged" with it under their iron jackets—to hold their steam.

The largest power - plants and many thousands of factories use it to maintain their high-pressure.

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For Heating, the biggest skyscrapers, hotels, public buildings use "85% Magnesia" to put the heat where it belongs and to save coal. In innumerable residences it insures even heat and cuts coal bills enormously.

For two years the Mellon Institute of Industrial Research of Pittsburgh University has been conducting experiments to prove the definite degree of its efficiency under varying conditions of temperature and pressure. A Table of the Monthly Coal Savings in Dollars and Cents has been prepared by this Institute, and the Magnesia Association will mail it to you for the asking. Also the illuminating book, "Let '85% Magnesia' Defend your Steam." If you are an engineer or architect, ask us for the Specification for the scientific application of "85% Magnesia" compiled and endorsed by the above Institute.

MAGNESIA ASSOCIATION of AMERICA

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TRADE PUBLICATIONS

"**Use of Acetylene in Navy Yards** During the War" is the title of the leading article in the October issue of "Autogenous Welding", published monthly by the Davis-Bournonville Co., Jersey City, N. J. We quote in part as follows: "To show that acetylene played an important part in the Navy Yards in winning the war, the following monthly comsumption of acetylene at some of the Navy Yards are interesting; New York used 110,000 cubic feet per month; Charlestown 15,000 cubic feet; Norfolk 60,000 cubic feet; and Boston 75,000 cubic feet. While one is likely to think of the oxy-acetylene process as a means of welding, it happens that in the Navy Yards more acetylene is used in cutting probably than in welding. The war demanded of the Navy Yards, working in many cases ten or twelve hours a day, the reconstruction of hundreds of ships, changing from the pursuits of peace to the transport of troops and cargo carrying of war. Every time a passenger or cargo vessel is converted into a transport, many changes are necessary. Bulkheads must be cut out or moved, ventilation must be installed, plumbing, berthing and messing fixtures must be made and put in place. During the war, time was the primary consideration and money the secondary one. The oxy-acetylene torch cuts its way through all obstructions and provided a quick and easily transportable means of accomplishing the desired end. Ships were converted, refitted and quickly sent on their way, carrying the transports which at the vital moment perhaps turned the war. Not only were the ships already in existence made over, but new constructions in private yards, in new shipyards and in Navy Yards were rushed to the limit. Practically every plate and shape involved in ship construction, both merchant and man-of-war, requires cutting to a greater or less extent to insure fitting, to provide for passage of pipes, for access doors and hatches, etc. The portability of the gas cutting torch permits the tool to be taken to the work rather than taking the work to the tool. In the field of armor cutting—and there are thousands of tons of armor in modern ships—the gas torch of course holds entire sway. Hydrogen here assists acetylene in the heavier cuts."

The A. C. Starting Switch is the subject of a circular issued by The Electric Controller & Mfg. Co., Cleveland, Ohio. Some points of advantage claimed for this starting switch are: "Hot wire overloads. Same principle used in meters. Gives time element feature and absolutely acurate. Arranged for conduit connection for leads coming from supply lines. Contacts of the magnetic contactor type. Renewable copper tips. Arc is broken vertically. No laminations used in any part of the magnetic circuit. Provision made for padlock so that no one but the right man can touch the switch. Sliding contact operated by either of hot wire overloads. Quick make and break by means of springs and toggles. Conduit connection for push button supplied with each A. C. starting switch. Conduit connection for motor leads. Starting switch can be mounted near motor. Push button near operator. Terminal board for motor terminals. Flexible leads from this board to fingers. Copper fingers with renewable tips. Adjusting nuts to take care of wear of tips."

Flexible Shaft Bulletin No. 104 has recently been issued by the Stow Manufacturing Co., Inc., Binghamton, N. Y. Ball bearing flexible shafts are described as follows: "Certain flexible shaft applications demand unusual high speed; for this work, our ball bearing flexible shaft, the hand piece of which is considerably shorter than standard, and is equipped with Norma high speed bearings which guarantee accuracy and prevent heating, should be used in all cases where the speed is greater than 3400 revolutions per minute. Shafts are furnished in No. 3, 4, 5 and 6 regular, and No. 1 and 2 may be had special. This ball bearing equipment has been found to be advantageous for special applications."

This Welded 2 Inch Pipe Stopped a Flood-Driven Barge—

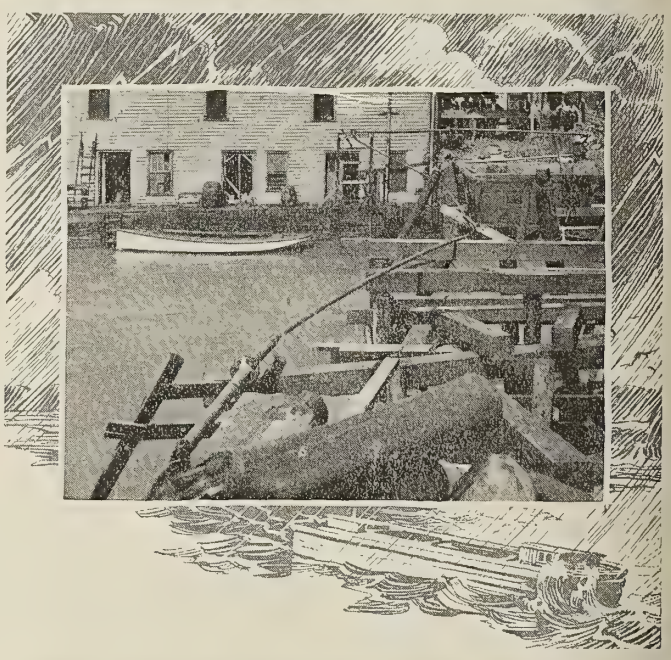
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To meet a temporary situation, the load from a 6″ high pressure gas main was put through this welded 2″ pipe line, laid on temporary piling across a river.

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It held them all. Not a single leak developed.

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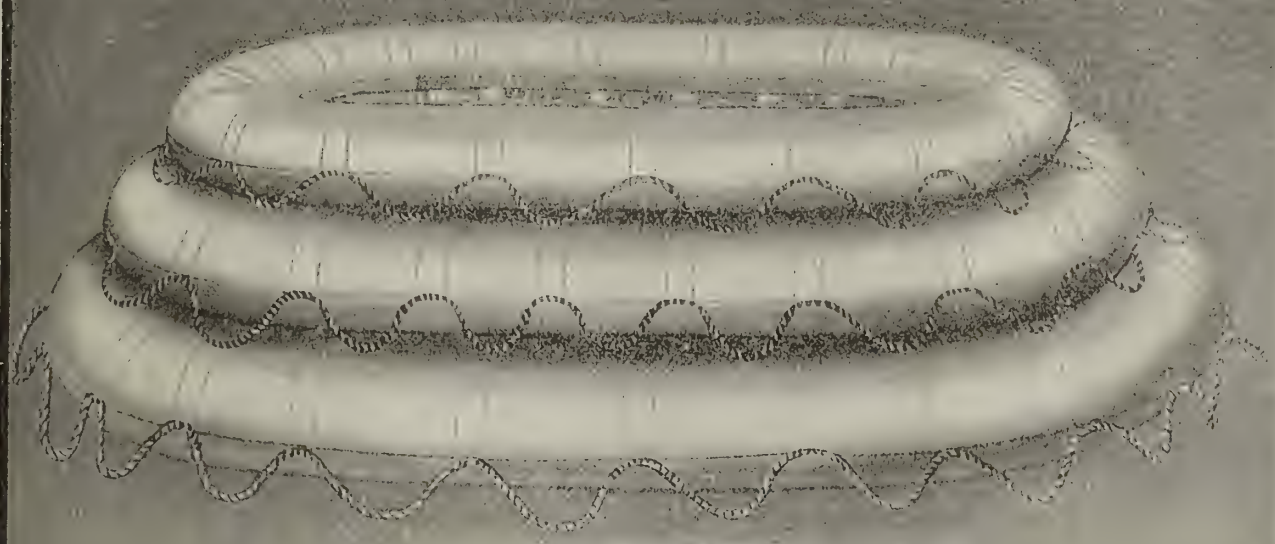
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"**The Electric Ship**" is the title of an illustrated booklet recently issued by the General Electric Co., Schenectady, N. Y. A complete description of the electrically propelled battleship *New Mexico* is the chief article contained in this booklet. The preface is as follows: "Electricity, at first merely an illuminant, has now captured the kingdoms of manufacture, transportation, and communication. It turns the wheels of industry, moves passengers and freight, and establishes direct communication between all parts of the world. Even the automobile and aeroplane—most recent achievements of modern ingenuity—depend upon the electric spark. And the wireless telegraph and telephone, which have bridged the seas for man's safety and convenience, are inherently electrical inventions. Electric drive for large battleships has only recently become a mechanical expedient, although electricity has for some time provided the same necessities and conveniences to those who live on water,—labor saving devices and even luxuries—that are available to the electric user on land. Like a great city the *New Mexico* has electric power and lighting plants, electric hoists, electric ventilation, electrified machine shop, carpenter shop, laundry, restaurant, and even a printing establishment. The electric motor does much of the heavy work for the sailor boys; it raises the anchor, moves heavy burdens and makes life comfortable. What is more logical than the application of electricity to the propulsion of ships, since it has already been extensively used for their lighting, for hoisting, ventilating, signaling, and cooking. Ships as they plow through the ocean waves are literally moving in an atmosphere of 'electrical waves!' What a contrast between the new and old! Modern days with our electrically equiped *New Mexico*, and the days of Ben Hur who, as a galley slave, toiled through the tasks now performed so easily by electricity. Thus has electricity, through man's ingenuity, conquered nature and advanced civilization at sea as well as on land."

"**Putting Mettle into Metal**" is the title of a handsomely illustrated booklet recently published by the Clark Equipment Co., Buchanan, Mich., This booklet, describing in detail the company's plant and the policies upon which Celfor tools are manufactured, states: "Mettle is quality—highest quality. It is spirit—conquering spirit. It is life—tenacious life. It is temperament—a distinctive vital force. It despises crass. It hates inferiority. It disdains the mediocre. It will have naught to do with common things. It glories in the highest and best. It is that intangible yet potent thing which laying hands upon the best of men touches their hearts as with a spark and enthuses them with the will to be and to do. It is the 'nerve' on which the spent runner wins the race. It is the dynamic of the thoroughbred. It is the source of hidden strength tapped by the gallant steed as he noses out a rival in the crucial moment of the handicap. It is toughness, stamina, endurance, vitality, bred-in-the-bone grit; it is all this and more. It is the inherent life and spirit of Celfor drills—the masterful quality built into them by earnest eager men whose product is their pride—the replica of the spirits of good men and true, wrought in the best of steel."

Portable Outfits for Oxy-Acetylene Welding and Cutting are described in a circular recently published by the Davis-Bournonville Co., Jersey City, N. J., "Convenience and safety of portable welding and cutting outfits demand special trucks and holding fixtures. The Davis-Bournonville cabinet truck provides permanent mountings for the regulators, and gages within a steel locker which also affords space for the torches, hose, accessories and supplies. The large wheel open truck carries the gas cylinders upright, securely chained in place. This outfit is not as complete as the cabinet truck. It is especially fitted for outdoor work as the 31-inch wheels traverse rough ground easily and the truck is not readily upset. The small wheel open truck, of the same general design as the large wheel open truck, is designed more especially for indoor welding and cutting and for use in general on floors, pavements and firm level ground. All Davis-Bournonville trucks are built entirely of iron and steel and are ruggedly constructed throughout."

IRON STEEL METALS

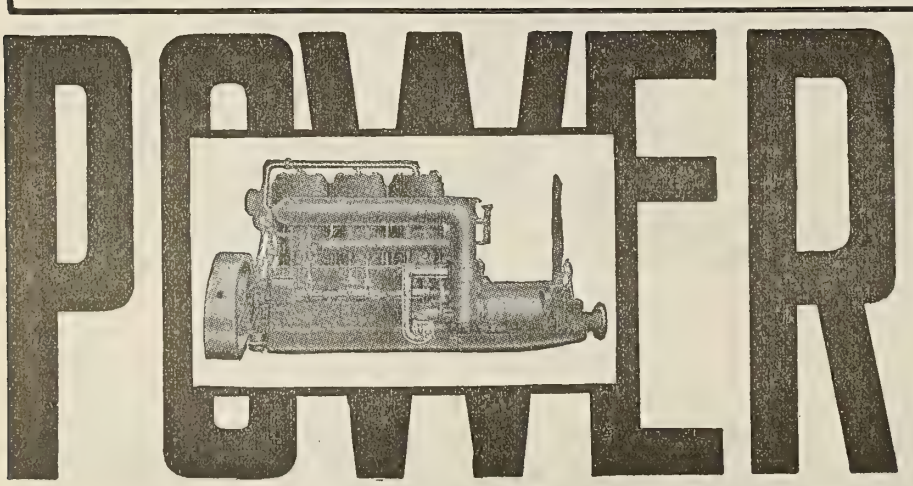
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PRACTICAL MARINE ENGINEERING

REVISED AND ENLARGED

By Rear Admiral C. W. Dyson, U. S. N.

This book is devoted exclusively to the practical side of marine engineering and is especially intended for engineers and students and for those who are preparing for examinations for marine engineers' licenses for all grades. It gives complete details regarding marine engines and all that pertains to them, together with much information regarding auxiliary machinery. It covers the general subject of calculations for marine engineers and furnishes assistance in mathematics to those who may require such aid.

Boilers, reciprocating engines, steam turbines and reduction gears (mechanical, hydraulic and electric), are treated exhaustively. A separate chapter deals with internal combustion engines (Diesel and heavy oil) and producer gas plants. Oil fuel burning and the latest practice in superheated steam are taken up in detail.

The chapter hearings include the following:

MATERIALS
- Fuels (coal and oil)
- Boilers (Fire tube and water tube)

Oil Fuel Burning
- Marine Engines
- Reciprocating Engines
- Steam Turbines
- Internal Combustion Engines
  - Gasoline
  - Heavy oil (Diesel)
  - Producer Gas

AUXILIARIES
- Pumps
- Condensers
- Feed Heaters
- Filters
- Evaporators
- Lubricating Devices
- Separators
- Blowers
- Pneumercators
- Time Firing Regulators
- Steam Traps
- Ash Ejectors, etc.

- Valves and Valve Gears
- Refrigeration
- Electricity
- Propulsion and Powering
- Operation, Management and Repairs
- Boilers, Engines, Turbines and Auxiliaries.
- Indicators and Torsion Meters
- Special Topics and Problems
- Computations for Engineers

The sixth edition has been enlarged by the addition of a chapter on miscellaneous machinery covering steering engines, capstans, windlasses, boat cranes, anchor engines, ash hoisting engines, towing engines, ventilating, heating and cooling apparatus, sirens and whistles, fire extinguishing and fumigating apparatus, reducing valves and regulating valves. The book now covers the latest practice in both propelling machinery with their auxiliaries and the deck machinery used in the handling of a vessel and her cargo.

MISCELLANEOUS MACHINERY

- Steering Engines
- Capstans
- Windlasses
- Boat Cranes
- Anchor Engines
- Ash Hoisting Engines
- Towing Engines
- Ventilating, Heating and Cooling Apparatus
- Sirens and Whistles
- Fire Extinguishing and Fumigating Apparatus
- Reducing Valves
- Regulating Valves

1067 pages. The book is illustrated with 550 diagrams and cuts, showing the most approved practice in the different branches of the subject. The text is in such plain, simple language that any man with an ordinary education can easily understand it.

PRICE $6.00

FOR SALE BY

MARINE ENGINEERING, 6 EAST 39th STREET NEW YORK CITY

The William E. Williams Company, New York, maker of marine equipment, has recently published a 445-page illustrated catalogue of its products. This book is valuable in that it practically amounts to a handbook of ships' stores, equipment and shipbuilders' material. No attempt has been made in compiling the book to include all the products carrying the "WEW" mark but needless to say it is sufficient to supply information on practically any equipment that might be needed by ships, shipbuilders, stevedores, dock builders, factories, mills, etc. Bronze valves of all types for use under pressure from 200 pounds to 350 pounds per square inch and iron body valves for 150 pounds and less are specified in detail. These valves are regrinding and supplied in screw and flange ends. Globe, angle and cross valves are also described in detail. One particularly interesting description of the low presure mechanical system for burning fuel oil is given on page 64 of the book which, in describing the "White" system states that it is the growth of numerous experiments to attain perfection in the burning of liquid fuel under boilers by means of mechanical atomization in conjunction with the positive supply of an amount of pre-heated air adequate for complete combustion. Complete combustion is the key to efficient oil firing. It is secured by a process called atomization: the breaking up of the oil into an impalpable mist of finely divided particles which when brought into contact with the proper amount of oxygen will unite with it to form carbon dioxide (Co_2), creating an intensely hot flame without soot or ash. In the "White" system this atomization is secured by forcing heated oil under moderate pressure through a specially designed burner which, by its mechanical construction alone, so pulverizes the oil that it issues from the burner-tip in the form of a hollow cone-shaped mist completely surrounded by air both thus dispensing with any wasteful outside atomizing agency such as a jet of steam or compressed air. With the oil in this condition it is only necessary to bring into intimate contact with it the proper amount of oxygen of the air in order to secure complete combustion. It is of vital importance, however, that the contact be so intimate as to secure a perfect admixture of oil and air and also that the supply be uniform, continuous and under positive control. Excess of air beyond that required for efficient combustion spells waste of heat. Surface condensers of cast iron, having tube heads of Munz metal and tubes of seamless drawn brass or Admiralty metal are included in the section dealing with marine and industrial pumps of various types. Ship chandlery and equipment are given with such descriptions of special devices as demand individual treatment. Under this head may be included the Tanner sounding machine which is "noted for its simplicity of construction and operation." The moving parts are permanently attached in their respective places and are practically non-corrosive. The friction brake is in full view and is operated by simply moving its handle to right or left, thus playing out the wire or checking it as desired. The dial shows approximately the amount of wire out, the exact number of fathoms being taken from the correction table at the top of the machine. The patent elastic chain stopper and surge reliever was constructed "to prevent parting of chains while riding at anchor in dangerous positions, and also to prevent the loss of life and property." But when it was put to use the discovery was made that vessels rode much easier, and anchors held on much longer than they had done before with the old method of riding by the windlass. No matter how sudden or powerful, the shock, it is reduced to a steady strain by the elasticity of this stopper, thus easing the vessel and the chain and anchor all at the same time. No chain can be parted when used with this stopper unless the chain is subjected to a greater strain than the Admiralty test. It possesses great advantages when getting under way in a harbor filled with vessels, as also in any narrow place where it may be necessary to suddenly drop an anchor. An anchor can be held by this stopper at any point when heaving in; also a chain can be over hauled and an anchor dropped as readily from this stopper as from the cathead, thus saving the time and trouble required to cathead an anchor. With it a second anchor is always ready to be let go, thus often avoiding a collision. It is very useful in fleeting the chain

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GEORGE STRATFORD OAKUM COMPANY Jersey City, N. J.

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HAVE PROVED THEIR WORTH

QUALITY SERVICE



RELIABILITY EFFICIENCY

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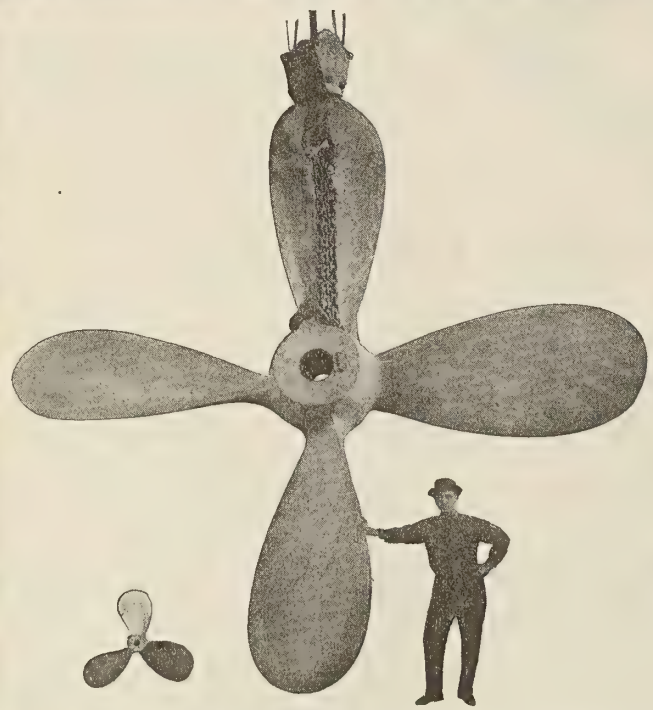
New York City Boston Philadelphia Baltimore Pittsburgh Cincinnati Buffalo St. Louis
Chicago Minneapolis Toledo Newark Newport News Detroit Atlanta New Orleans Sabine

when using a wooden windlass, as it does away with the apparatus called the devil's claw. When it is necessary to fleet the chain, all that is required is to slacken the chain and slide it down on the windlass—the stopper holding the anchor as soon as the chain is slackened—therefore, there is no chain lost that has once been hove in. Sections are devoted to complete stateroom and lubricating appliances and fittings, deck fittings, rigging, electrical equipment, ship instruments, taffrail logs, etc. Machine tools, carpenters' tools, screws, bolts, nuts, and hardware in general are listed. Among the engine room fittings described is the altitude gage which will indicate accurately at the boiler the height of water in the system and will be found very useful. When the water is at its proper level in the expansion tank, the ring and glass of the gage are removed, the stationary hand set at the pressure indicated by the work hand. When the pressure falls below this point water should be added. Pressure and vacuum gages are given for "all ranges of pressure and vacuum from full vacuum to 20,000 pounds per square inch, which are furnished for use on air, steam and liquids with charts graduated in many different units, such as pounds, ounces, inches and metric units." Steam traps, injectors and lubricators are also described in detail. For the boiler room the regular tool and pipe fitting equipmen are listed with a great variety of tube cleaners, scrappers and roller expanders. It would be impossible in the short space available to give a comprehensive idea of the vast variety of equipment and devices for marine and industrial uses dealt with in this catalogue, but it may be summed up in the word "complete."

"The Only Screw Holes in the World" are described in a folder issued by The Stine Screw Holes Company, Waterbury, Conn. Some of the advantages of screw holes are: "They can be used without damage to receiving material; they enable you to standardize to wood or machine screws in all material; they are made of brass and will not rust under atmospheric or moisture conditions; special tools are not needed in using them in any material; they can be used in any place a screw can be used; no special screws are needed—these screw holes fit any wood screw or machine screw now in stock; they make the neatest possible job in any material; they are endorsed by all dealers in screws and by all users of screws; in spite of the high cost of brass, screw holes are yet cheap; they make everlasting holes in any material; and anyone who can drive a nail can use screw holes."

The Milwaukee Crane is described and illustrated in a booklet isued by the Milwaukee Electric Crane & Mfg. Co., Inc., Milwaukee, Wis. We quote in part as follows: "The Milwaukee crane is the result of more than 25 years' experience in the designing and building of hoisting machinery for shops, foundries, steel plants and other establishments. Only those features which have proved desirable and essential on the score of safety, durability and convenience have been retained, and in addition thereto, self-oiling and other features which make for greater safety and durability, have been incorporated at an added expense in construction over the older practice simply because the extra cost is justified in the long run. Delays are expensive and usually due to neglect, intentional or otherwise, but in building the Milwaukee crane, the item of injury to the mechanism of the crane, due to neglect, has been reduced to a minimum. Every element in the design has stood the test of time and hard usage under all contidions of service."

"How Thermit Cured My Diseased Neck" is the title of a folder issued by the Metal & Thermit Corporation, 120 Broadway, New York. This folder illustrates a thermit welding repair, consisting of building up with thermit steel the worn rods on the end of the 16 inch diameter neck of a large roughing mill pinion used by the Universal Rolling Mill Co., Bridgeville, Pa. The company states, "It may be unprofessional for a physician to advertise, but that doesn't alter the fact that for surgery on roll necks, pinion teeth, crankshafts, shears, housings, or any other heavy steel sections thermit welding is the only reliable doctor."



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PITTSBURGH: The New Jersey Zinc Co. (of Pa.) 1439 Olicer Building.

Manufacturers of Zinc Oxide, Slab Zinc (Spelter), Spiegeleisen, Lithopone, Sulphuric Acid, Rolled Zinc Strips and Plates, Zinc Dust, Salt Cake and Zinc Chloride.

"**A New Development in Boiler Feed Pumps**" is the subject of a booklet recently issued by the Coppus Engineering & Equipment Co., Worcester, Mass. The booklet states, "Up to now the enormous demand for small boiler feed pumps has been met almost entirely by reciprocating pumps, although the advantages of centrifugal boiler feed pumps have become so generally recognized that they are almost exclusively used at present for large capacities. Centrifugal pumps are either electro motor or steam turbine driven. In either construction the motor or turbine respectively, and the pump, are separate units connected by a flexible coupling and mounted on a cast iron base plate. Motor driven centrifugal boiler feed pumps are seldom constructed for small capacities, for the reason that the pressure head of a single impeller is small on account of the comparatively low speed of the motor, necessitating a large number of stages. This not only is costly in construction, but also in maintenance, and therefore unpractical. Steam turbine driven centrifugal pumps are also seldom constructed for small capacities because a good steam turbine, built as a unit it itself, and mounted on a base plate, is too expensive to connect to a small centrifugal pump, making competition with the duplex or simple steam pumps impossible. Yet an efficient turbine driven centrifugal boiler feed pump for small capacities has so many advantages over the reciprocating steam pump that its need has been keenly felt for a long time. Such a pump, therefore, is bound to receive a welcome reception by the owners or operators of small power plants. With the requirements of such a pump clearly in view, it has been our aim to produce a pump of the most simple design with a comparatively high efficiency, a machine that is built in very compact form to withstand severe usage, to occupy very little floor space, to operate smoothly and continuously without interruption. After years of study and experimentation we have developed the Coppus Type CCC centrifugal turbo boiler feed pump. It contains the best elements used in modern turbine and pump practice, ingeniously combined to make up a simple and dependable boiler feed pump."

"**Boiler Logic**" is the title of a booklet issued by the Heine Safety Boiler Co., St. Louis, Mo. "While it would be to the advantage of the manufacturer to produce and market a single universal design of boiler, such standardization cannot be attained; the modern boiler must be adaptable in design and setting to the multiplicity of requirements of fuels, furnaces and operating conditions. A single rigid construction is not suited to all plant conditions. Flexibility of design is essential and the arrangement in any case for hand firing, stoker firing, fuel oil, waste heat, etc., depends on certain fundamentals of combustion and heat transfer which will be briefly considered. In combustion, heat is generated from the latent energy of fuel, and since the boiler design and setting influence in some degree the efficiency of this process, we will consider briefly the essentials of furnace design. The heat liberated by combustion is almost all available for generation of steam, and, therefore, efficient boiler design from the standpoint of heat absorption, is the next essential." The principles of boiler practice are dealt with at length in this booklet as well as the various types and sizes of Heine Boilers that may be adapted to special power plant needs.

Ingersoll-Rand Air Lift Pumping is the subject of a circular published by the Ingersoll-Rand Co., 11 Broadway, New York. If interested in this air lift pumping, ask for catalogue No. 76. This company states: "The engineer of a Georgia water works writes that his Ingersoll-Rand air lift has been shut down but once in 11½ years, while a new deep well pump installed in another (shallow) well has had to be pulled for repair 15 times in 13 months. For reliable pumping service there is nothing like the air lift and an Ingersoll-Rand air compressor."

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In all the various grades it is the best for the money—the most serviceable. Pound for pound it will go further and do a better and a more lasting job than any other make. Do not be deceived by cheap imitations; see that the trade mark is on every package.
Send for booklets: "MARINE GLUE—WHAT TO USE AND HOW TO USE IT" and "HOW TO MAKE YOUR BOAT LEAK PROOF"
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Fire Department Supplies
ANDREW J. MORSE & SON
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221 HIGH ST., BOSTON, MASS.
DIVING APPARATUS


FOR SALE

Triple Expansion Marine Engine 18" x 32" x 54"—42" stroke. Has been in service fifteen lake seasons in a wooden steamer of 3000 tons capacity. Has been thoroughly overhauled and is in A-1 condition. Shipping weight approximately 70 tons.

Windlass, 8 x 10 of Providence manufacture, suitable for 1¾" stud link chain. Arranged for capstan drive. In first class condition.

Both subject to inspection. Immediate delivery.

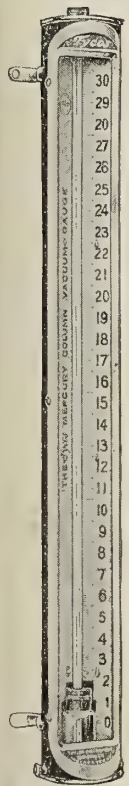
McDougall-Duluth Company
Duluth, Minn.

Bench Legs, Work Stands, Vise Stands and Bench Drawers are among the many types of shop furniture described and illustrated in a catalogue published by the New Britain Machine Co., New Britain, Conn. A typical treatment of one product, bench drawers, will serve to indicate the method used in this catalogue to describe all the products manufactured. "With the passing of the old wooden drawer we must record its one virtue—it would not of itself damage edged or pointed tools thrown in carelessly. Among its recognized faults, on the other hand, were sticky action, incomplete exposure, liability to come off the slides and dump contents or to break down either slides or drawer when fully opened. Then, too, in the common type of bench now almost universally used, with thinner back plank than front one, there is an open space between the plank and the back of the drawer which invites pilfering. A bench drawer should thoroughly protect and display its contents and be of convenient dimensions for proper stowage. In the designing of what is thought to be a superior drawer for shop use, we have retained wood for the back, bottom, and front. Fine edged or precision tools can therefore be laid in same without injury. The drawer is long enough to hold, laid straight, the longest file or hammer that a machinist is liable to use, and broad enough to accommodate a considerable variety of tools without laying them one upon the other. The drawer is sold as a unit and is so applied, by anyone capable of inserting a few screws, without any cutting of the bench. There is no assembling to be done, no loss if it is ever desired to move drawer. When shut and locked it cannot be entered or removed without breaking. A smooth plate over the drawer opposes any tampering at the rear and prevents blocking or a lockout through wedging of contents. The drawer runs on anti-friction rolls on finished surfaces, giving that smooth movement which prevents shucking disturbance, while the familiar cramping and wedging of bureau-drawer action are entirely prevented by parallel motion mechanism consisting of cross shaft and pinions on racks. The racks are inverted, so that dirt will not clog nor wear the pinions. So easy does the drawer work, even when fully loaded, that it can be handled by one free hand, either from end or middle. It is impossible to make it bind. Cylinder lock of good grade with two individual keys is provided. Master keying, if desired, may be had at cost. The possession of master key by foreman will prevent any contraband being stowed in drawers."

Catalog M., recently issued by the Thacher Propeller & Foundry Corporation, Albany, N. Y., lists the following among the products manufactured: anchors, bitts, capstans, castings, cleats, chocks, deck irons, forgings grates, hawse blocks, propeller wheels, ventilators and heavy marine hardware. "It is our pleasure to submit in this catalog various articles of marine equipment of our own manufacture. Each article illustrated is manufactured complete from the raw material to the finished product, at our works, at Albany, New York. We aim to build the best that can be produced by combining long experience and careful study with selected material and the finest workmanship. In all cases we stand behind our product with a guarantee as to quality of material, workmanship, design and durability in operation."

Lubricating Oil Storage Systems are the subjects of bulletin No. 65, issued by the Wayne Oil Tank & Pump Co., Fort Wayne, Ind. "The battery method of handling, storing and distributing lubricating oils assures the user that the barrels will be entirely drained, that the liquid will be safely stored in practically fireproof containers, free from dust and dirt, and that every gallon can be accounted for. Tanks are made in capacities of two barrels and up in battery form and can be added to as needed, height and length from front to back of the entire battery remaining uniform and width across front varying acording to capacity, economizing floor space to the greatest possible degree."

Are the Instruments Aboard Your Ship Dependable?



Mercury Column Vacuum Gauge

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Tycos Mercury Column Vacuum Gauge

An instrument harmonizing in its characteristics with the highest grade of engine room equipment. A credit to any gauge board. Length 37⅞", diameter 3½", center to center of bracket holes; vertical 30⅜", horizontal 4¾".

Tycos Shiphold Thermometer

Mounted in a clyndrical galvanized-iron case fitted with rubber buffers. Originally designed for use on board refrigerated ships, for lowering into hold thru a tube but can be used for other purposes, such as determining temperature of stored coal, etc.

Can also used as an inexpensive form of Brine Tank Thermometer, its rugged construction permitting of its being suspended in the brine. This thermometer is filled with red liquid and has magnified column.

Write for Prices

Taylor Instrument Companies
ROCHESTER, N. Y

There's a Tycos or Taylor Thermometer for Every Purpose



Shiphold Thermometer



SCALE—AND THE CURE

Boiler scale cannot be prevented from forming, but there is a way of removing it easily.
The answer is to use

Dixon's Pioneer BOILER GRAPHITE

It is introduced into the boiler feed water. The particles work their way through the minute fissures of the scale, lubricate the scale, so to speak, and greatly facilitate subsequent cleaning by ordinary methods. Once clean, scale cannot again burn fast to the metal.
Both time and labor costs are cut in half, and cleaner boilers are the result.
Graphite has not taste or odor, nor is it soluble. It does not prevent the use of live steam for cooking or washing. It does not destroy gaskets, valves and fittings on steam lines.

Write for Booklet No. 75-T and further information.
Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE CO.
ESTABLISHED 1827

Fluid Meters for Low Pressure Gas and Air are described in bulletin No. 30, issued by the Bailey Meter Co., Cleveland, Ohio. The introduction reads as follows: "The Bailey Meter Company has developed a meter for the measurement of low pressure gas and air, the design being such as to give the same power and accuracy on two-inch water differential as our standard fluid meter gives on two pounds differential. The company has been manufacturing various types of meters since January, 1916, these meters having been developed and perfected during the past ten years. They are particulary adapted to the many and varied needs of modern power plants, gas works, steel mills, chemical works, and in fact all large producers or users of power. They have been developed as a result of a long and intimate knowledge of the actual operating conditions, needs and demands of this line of work, and have proven rugged and dependable, giving accurate results over long periods of continuous service. Above all they are designed to give reliable information and results in the forms that are most useful and comprehensive to the fireman, engineer, or other attendant in charge, as well as to the superintendent and those interested in efficiency and operating costs. Judging by the results obtained from the large numbers of meters that have been in continuous service for a number of years, we have no hesitation in stating that we have by far the most complete and the very best line of meters for measuring the flow of all fluids."

Electric Air Compressors, Portable Electric Drills, Electric Valve Grinders, is the title of a catalogue recently issued by the Black & Decker Manufacturing Company, Baltimore, Md. The object of this book is to bring out the three fundamental qualities, design, material and workmanship of mechanical devices produced in Black & Decker plants. "Long before the first Black & Decker Lectroflater Electric Air Compressors or Portable Electric Drills were placed on the market The Black & Decker Manufacturing Company designed and built special machinery, such as currency presses for the United States and Canadian Governments, postage stamp machines, duplicators, milk bottle cap machines, moving picture cameras and projectors, shoe machinery and special tooling for other manufacturers' production work. During the war they made, in addition to the regular line of Lectroflater Electric Air Compressors and Black & Decker Portable Electric Drills, such percision apparatus as gun sights for naval rifles, breech mechanisms for airplane cannon, demolition and incendiary bomb firing mechanisms, etc. It is obvious that sound engineering ability must be the basis of such work and one logically expects—and finds—the predominating feature of Black & Decker products to be their advanced design. The result of such experience has been the inculcation of an acute sense of material values, which insures the use of correct materials in all Black & Decker products. Work such as that mentioned requires the utmost exactness and has developed the ability of the organization to perform accurate work. Good workmanship has become a habit and is an outstanding characteristic. At the first opportunity examine a Black & Decker electric drill, valve grinder, or air compressor. You will appreciate the fine workmanship they evidence. We have no hesitation in ascribing a large portion of the mechanical perfection of our products to the unusually fine morale of our entire organization, due to what might a few years ago have been termed an idealistic policy, but which is now recognized as the fair and sound business policy of cooperation between management and the manufacturing organization. In other words every man is working with his hands and individual mind in cooperation with every other toward the common welfare, and is not merely a cog in a machine doing a daily stint without knowledge or interest in the finished product."

"Chelsea" Clocks are described in Catalogue F., recently published by the Chelsea Clock Co., 16 State St., Boston, Mass. This company makes a specialty of striking ship's bell clocks.

Williams' Superior Drop-forged Wrenches are described and illustrated in a catalogue recently issued by J. H. Williams & Co., 61 Richards St., Brooklyn, N. Y. Prices are also quoted for the various types of wrenches manufactured by this company. A copy will be sent to any reader upon request.

"Overcoming Difficulties Constitutes Progress" is the title of the leading article in the October issue of "Staybolts", a bi-monthly digest published by the Flannery Bolt Co., Vanadium Building, Pittsburgh, Pa. We quote in part as follows: "There is a reason why we are advocating so strongly the use of the F. B. C. type of flexible staybolt, and why we so persistently followed the idea of welding the sleeve to the outer boiler plate. We believe that it is the only means by which the sleeve connection to the outer plate can be made steam tight, and that it is more reliable and economic to maintain in service than the threaded sleeve connection heretofore used for the Tate flexible staybolt. Our belief is the result of many years' investigation and study of the present standard type of flexible staybolt in use, and a description of the experiences and difficulties met with in this investigation will convince mechanical officials of the railroads that the welded type of flexible staybolt is esbe eliminated by the threaded type of sential to remove defects that cannot flexible staybolt now in general use."

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39 Elmbank Crescent, Glasgow

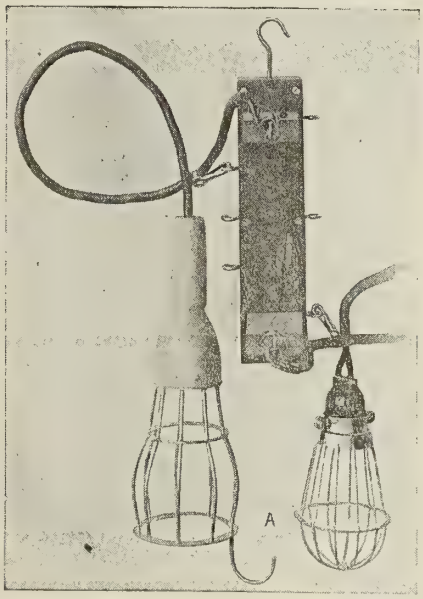
NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

"Our Activities are Four-Fold" is the statement made in a booklet recently issued by the Vibration Specialty Co., 239 N. Watts St., Philadelphia, Pa. We quote in part as follows: "We manufacture balancing apparatus, (latest Akimoff designs), and all sorts of special machinery for the study and elimination of vibrations. We do practical balancing, both in our laboratory and in the field; all weights and sizes. We design high-speed parts, such as crankshafts of gas engines; and special rotors of all kinds. We do research work along all lines of mechanical engineering. We are affiliated with two other laboratories and have facilities for working out all difficult problems of engineering practice. We are absolutely independent and have never been connected with any other concern. We have been very successful, made numerous friends, whom we certainly intend to keep, and all our goods and results are absolutely guaranteed in every respect. We do not guarantee the performance of any other apparatus, or the correctness of anyone else's statements in regard to balance or its problems. We always have our apparatus approved by the United States Navy Department, and exceedingly regret that their rules prohibit us from quoting the reports of their experts. We have done work balancing for the U. S. Navy from the first day we started."

"The Big Jobs Come to Todd" is the statement made in a handsomely illustrated booklet recently published by the Todd Shipyards & Dry Dock Corporation, 15 Whitehall St., New York. A brief description of the repairing of the S. S. *Lord Dufferin*, at the plant of Robins Dry Dock & Repair Co., is given as follows: "The renewal of the after section of the British freighter *Lord Dufferin* attracted so much attention that we kept, as far as weather conditions would permit, a photographic record of the progress made while the vessel was in the yards of the Robins Dry Dock and Repair Company, our Erie Basin, Brooklyn, plant. The razor-like stem of the *Aquitania* had cut the freighter completely in two at a point about twelve feet forward of the poop deck and just aft of cargo hatch No. 5. The section to be restored measured sixty-four feet and a small scale outline, a deck plan and a photograph were the only guides available. The job was completed in the record time of eighteen and one-half working days and when the *Lord Dufferin* left the dock the new section had been so skillfully built on that the water lines and sheer lines vanished into the orginal portion of the hull so perfectly that it was impossible to detect that twenty percent of the hull had been rebuilt. Following the collision the freighter was raised and, aided by pontoons, towed to the Erie Basin yards and placed in the graving dock. The after portion of the vessel, including rudder, stern frame, propeller, tail shaft, stern tube, two lengths of intermediate shaft and machinery and fittings in the section, was lost. Three molds were taken of the sound portion of the hull at equal distances just forward of the cut. Lines were then run for the new stern and faired up to the satisfaction of owner and surveyors. Molds were made of all frames, beams, floors, keelsons, stringers, tanks, tunnel recess, bulkheads and deck-plating. The entire stern overhang, from and including the transom frame aft, was fabricated, assembled and riveted together on shore and after being hoisted in place was secured on stays. While this work of reconstruction was under way the propeller, tail-shaft, stern tube, intermediate shafts, bearings, hand steering gear, rudder, fittings, winches and accommodations were rushed to completion so that there would be no delay in their installation as soon as the work on the hull had advanced far enough to receive them. Following the erection of frames, floors, beams and stringers templates were made of the shell plating, the material fabricated, hung on the ship and riveted."

"LITEHOLD" Portable Strip and Plugs



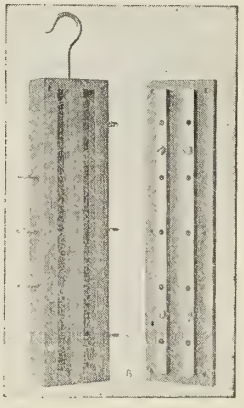
For temporarily lighting Hulls of Ships under construction

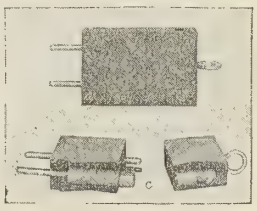
Illustration A.—Strip and 2 Plugs showing different type guards.

"B" carbolineum treated maple base with fibre top and brass connections for 5 plugs, Base 10½ in long, 2½ in. wide 1 13/16 in. thick.

"C" hard rubber plug, 1-in. thick 2-in. wide, 3⅛-in. long, with brass prong contacts and midget enclosed fuse. Fuses 2 to 15 amp. as desired. Note supporting hook, also snap hook strain relief for plugs.

OKONITE hard service cord recommended for use with above.





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Manufacturers and Distributors Electrical Supplies
50-52-54 North Fourth Street, Philadelphia
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Okonite—Wireless Cables—Tapes Holtzer-Cabot—Motors—Generators, Etc.

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Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired and they will be forwarded without additional charge.

Wanted—Steel Tug, 100 to 115 feet long, 500 to 700 H. P. New boat preferred. Address, giving full particulars, P. O. *Box 477.* Charleston, S. C.

College Graduate, scientific course, first class traded machinist experienced in marine engine construction, coal and oil firing, splendid health and physique, executive experience; success with labor; 34 years of age, married. Permanent connection desired, $55 week. Address *Box* 209, care of MARINE ENGINEERING.

Wanted—A High Grade Superintendent for structural and plate shop, capacity one thousand tons per month. No one need apply who is not a first class, well educated, thoroughly experienced man, with good references. Apply *Box 807*, care of MARINE ENGINEERING.

Marine Engineer—Wanted for an important and permanent position a high-grade marine engineer to take full charge of work. Excellent opportunity. Large Company. Location New York. Address *Box* 28, care of MARINE ENGINEERING.

Wanted—A Marine Auxiliary Draftsman, capable of designing steering engines. Permanent position. Give age, experience, education and salary expected. *The Main Electric Company*, 35 Commercial Street, Portland, Maine.

Wanted—Technical Graduate familiar with Marine Engineering specifications, first-class marine engine, electrical and pipe draftsmen. Permanent positions for right men in shipyard near New York City. Address *Graduate*, care of MARINE ENGINEERING.

For Sale—One 13-inch General Electric type P. C. thirteen, twenty-ampere, one hundred fifteen-volt direct-current searchlight, complete with rheostat, overhauled and in A-1 condition. Three 67-foot and three 75-foot cargo booms in good condition. Address *Freeport Sulphur Company*, Freeport, Tex.

Oil Engine Drawings for sale in full sets of standard shop working drawings. For 5,000- and 9,000-ton steamers, four-cylinder, 24 by 36, 1,450 horse-power, by 96 sheets, $1,200; for tugs, four-cylinder, 18 by 27, $1,000, and four-cylinder, 16 by 24, $900. For yachts or as auxiliaries, steel column crosshead type, 10 by 12, $900; 6 by 8, $600; 4 by 5 trunk piston, $300. Address *Fuel Oil*, care of MARINE ENGINEERING.

Basic Patent Rights on Rotary Engine for sale. The Rotary is the ideal engine for driving pumps, blowers, generators, etc. Address *Rotary Engine*, care of MARINE ENGINEERING.

Scientific Scale Removal is the name of a booklet published by the Lagonda Manufacturing Company, Springfield, Ohio. "Wherever modern steam turbines, engines, generators, etc., are used it is generally admitted that the practical limit in efficiency has been reached and that at best a further increase of only two or three percent can be expected. At the same time it is equally well known that an efficiency of seventy percent in the boiler room is exceptional, and that as a general rule the boiler only gets from thirty to fifty percent of the total available heat-energy of the coal into the steam. It is therefore evident that in most power plants an increase in efficiency of from thirty to fifty percent is possible in the boiler room; and this accounts for the unusual amount of attention that at the present time is being given to the economical operation of the boiler plant. We were one of the first firms to appreciate that scale removal by means of mechanical cleaners was the most thorough and statisfactory, and over twenty years ago we built our first tube cleaner. Since that time the improvements in cleaners which we have devised have been many. The result is that at the present time we have over seventy different cleaners from which an engineer may select the one best suited to his requirements. We do not believe that any one type of cleaner can be used in all places, and inasmuch as we manufacture such a variety of types, our advice as to the best design for a given case is unbiased. For badly scaled tubes, or for plants where scale conditions are very severe, or where scale has to be removed quickly, there is no method that can compare with the use of our mechanical cleaner, because it is driven from the outside the boiler and there is absolutely no limit to the amount of power that can be applied to the head. In fact, one of these cleaners when belted to a steam engine or electric motor, or direct connected to one of our external motors, can develop enough power to bore its way through a stone wall. The mechanical cleaner greatly reduces the time that a boiler is out of commission and on an average a mechanical cleaner will clean a boiler in one-third the time that would be taken by an ordinary turbine cleaner, and it will easily remove scale from tubes that a turbine would not touch. In addition to this, there is a considerable saving in the water used and the cost of pumping it."

Nickel and its Products is the title of a booklet issued by the International Nickel Company, New York. "The purpose of this booklet is to convey to buyers, in a concise manner, a description of our Nickel Products. it is intended to serve as a guide when forwarding inquiries or when soliciting information pertaining to Nickel." A general history of the Nickel industry on this continent is also given from the year 1866 when John Wharton first produced commercial metal from the ores of his mine at Lancaster Gap, Pa., down to the year 1902 when the company formed under his control, as well as several others, became consolidated under the name of the International Nickel Company. The catalogue treats of the production and uses of nickel in metallic form, as an oxide and in the form of salts by this company from that time to the present.

The Hercules Line is a catalogue produced by the Hercules Machine Company, Inc., New York, which describes the machinery necessary to the economical manufacture of lumber, building material, furniture, etc. "Economy has been made possible by recent improvements in woodworking machinery. In the past ten years a very large number of new machines, designed to save labor and produce more and better work, have been introduced. So many have been these improvements that the perfectly equipped modern mill or shop bears little resemblance to one of the older type. While conservatism in regard to the adoption of new machines is always desirable, the shop or mill manager should make a careful study from time to time of new improvements and inventions relating to the Woodworking Industry. Otherwise his plant cannot be maintained in an up-to-date condition, so as to be capable of turning out the maximum quantity of finished product. In this catalogue we illustrate our latest improved types of woodworking machinery. These machines embody many improvements over the early patterns, which have been suggested by actual experience in their use under all conditions. The engravings give an idea as to the many improvements in our machines, strength of their construction, and their complete adaptability to all purposes for which they are designed. We extend to all users of woodworking machinery a very cordial invitation to visit our factories for the purpose of inspecting our machines while in the course of construction."

National TRACING CLOTH

America's Own

A tracing cloth,
national in use and *national* in popularity
—the only cloth of American make.

A tracing cloth to which you can entrust your choicest plan; upon which you can trace from the faintest pencil line—a super-transparent cloth which assures clear, legible tracings that retain an unusual degree of freshness even after much handling.

Supplied in rolls of 24-yard lengths and in widths of 26 in., 30 in., 36 in., and 42 in. Also in flat sheets, cut to the size you specify, printed in our own plant with border lines and corner card, with insoluble jet black ink, ready for use with no waste of cloth or of draftsman's time in lettering.

NATIONAL TRACING CLOTH is backed by the strongest possible guarantee. Every roll or cut sheet not merchantable, not free from blemish, will be replaced, anywhere.

If you are not now using NATIONAL TRACING CLOTH we confidently invite your personal test of NATIONAL for the purpose of comparison with the cloth you now use.

Send the coupon for a free sample sheet today. Test it thoroughly!

NATIONAL TRACING CLOTH CO.

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National Vellum *National Tracing Paper*
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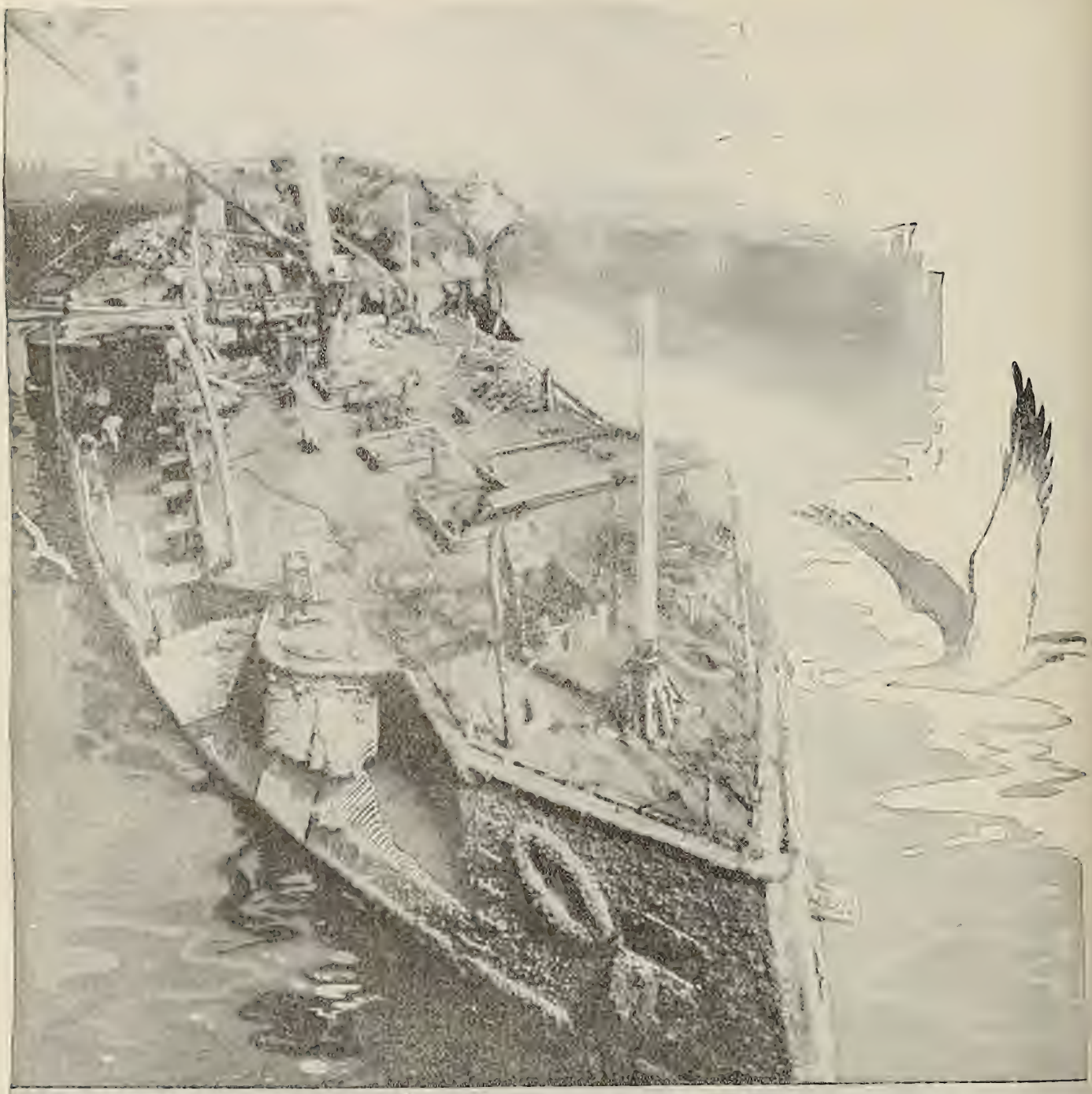
107-3

To THE NATIONAL TRACING CLOTH CO., Saylesville, R. I.
Please send me a sample sheet of NATIONAL TRACING CLOTH G for comparison with the cloth I am now using.

NAME _____

ADDRESS _____

FIRM OR COMPANY _____



From Photo © Brown Bros., New York City

WORTHINGTON

Worthington Works
Harrison, N. J.
Blake & Knowles Works
East Cambridge, Mass.
Deane Works
Holyoke, Mass.
Hazleton Works
Hazleton, Pa.



When writing to advertiser, please mention INTERNATIONAL MARINE ENGINEERING.

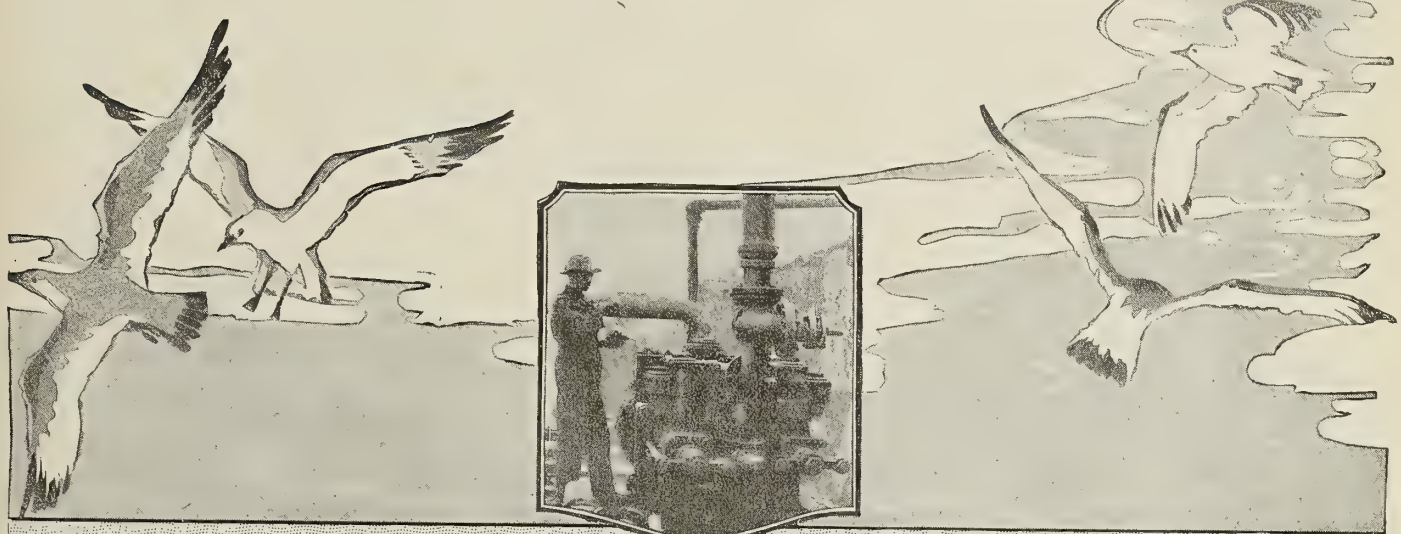
Sunk with the Maine, this pump helped to raise her

FOURTEEN years at the bottom of the sea—and still a good pump. That is the record of a Worthington Pump (made in our Blake & Knowles Plant) which went down in 1898 with the Maine. Several years ago, when the famous old battleship was raised, this pump with but two new parts—a piston rod and a valve rod—was connected up and assisted in unwatering the vessel.

That the Navy did not need this evidence of endurance and stamina, however, has been amply proven by the fact that most of the vessels of the American Navy are now equipped with Worthington pumps.

The ability of Worthington to meet the exacting demands of the naval engineers is but another reason why the name Worthington is usually found in well-planned industrial plants.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities



-METERS-MINING-ROCK CRUSHING & CEMENT MACHINERY

WORTHINGTON

Snow-Holly Works
Buffalo, N. Y.
Laidlaw Works
Cincinnati, Ohio
Power & Mining Works
Cudahy, Wis.
Gas Engine Work
Cudahy, Wis.

Westinghouse

Bringing Fuel Costs Down—

Before the war the Matson line operated two 15,000-ton passenger liners, the S. S. Matsonia and the S. S. Maui, between San Francisco and Honolulu.

With the exception that the Matsonia has reciprocating engines and a single screw, while the Maui has Westinghouse Geared Turbines and twin screws, these ships are otherwise alike.

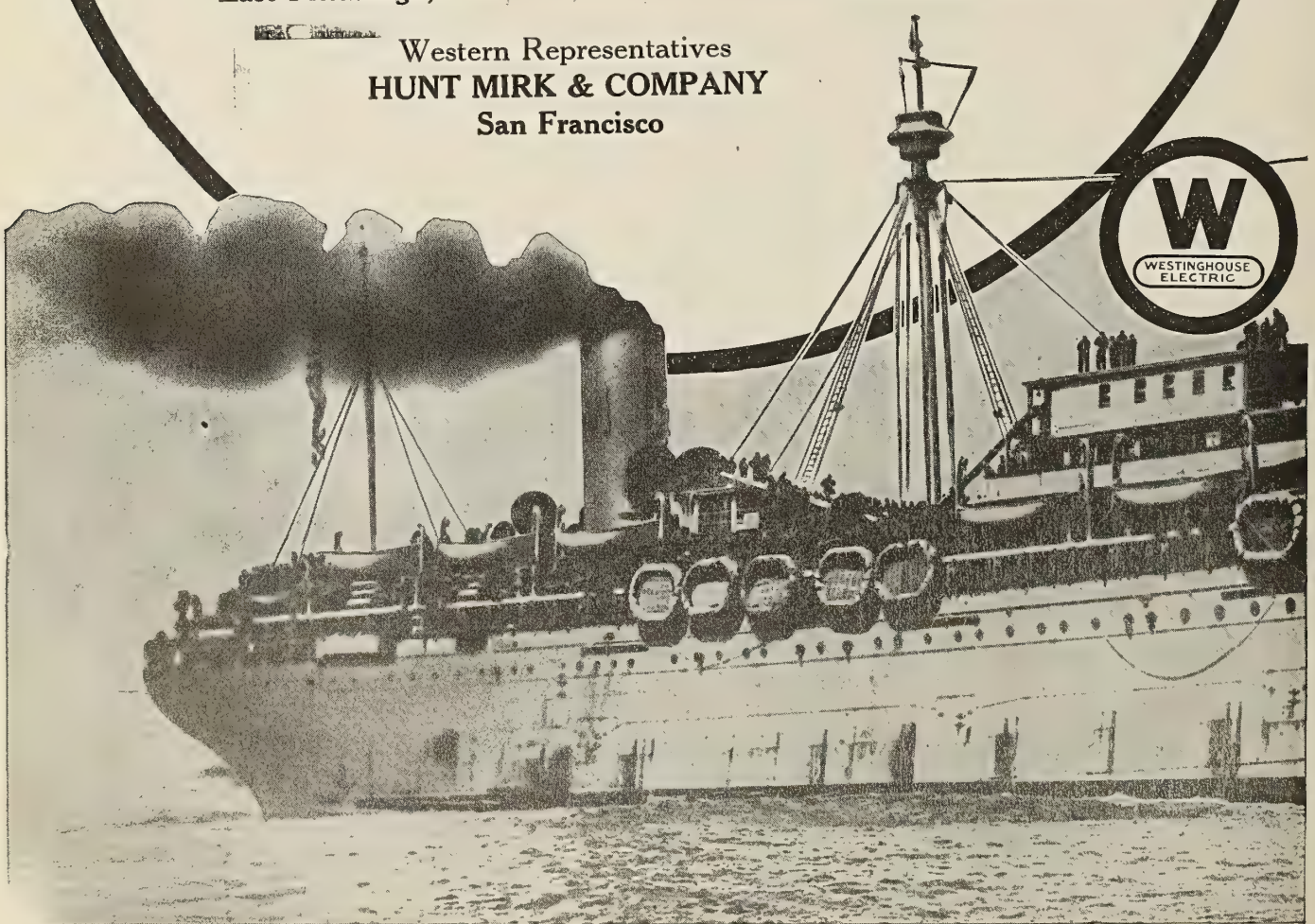
A careful record of the fuel oil consumption (sea steaming only) was kept on both ships for five voyages while both were in the same service and subjected to the same weather conditions, the difference in average voyage displacement being only eight tons. The result was a saving in favor of the Maui of 23%.

The general tendency toward turbine drive is indicated by the fact that within the past two years, 100 ships have been equipped with Westinghouse Propulsion Machinery.

Turbine drive affords not only a material reduction in fuel costs, but also a reduction in weight of equipment, more cargo-carrying space and a marked reduction in maintenance expense.

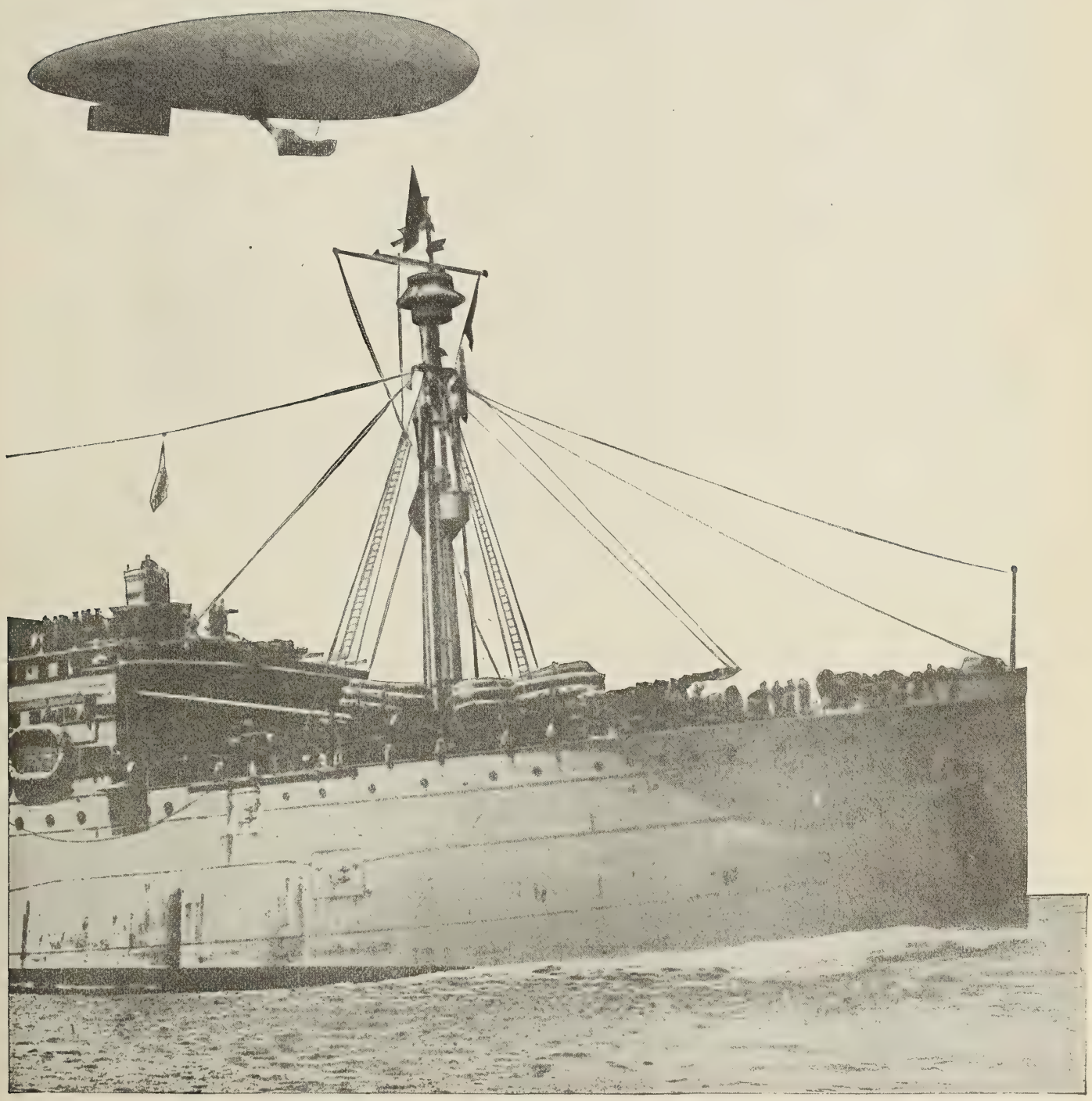
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
East Pittsburgh, Pa. **Washington, D. C.**

Western Representatives
HUNT MIRK & COMPANY
San Francisco



Marine Equipment

U.S.S MAUI



The Best in Machine Tools For Marine Equipment Manufacture

WE BUILD machinery for ship shed use—keel bending machines, plate planers, garboard bending machines, flanging presses, shears, radial drills—machinery for the manufacture of the heaviest marine boilers, special equipment for handling armor plate, guns and gun mounts.

For marine engine and steam turbine manufacture our line of heavy duty machinery is representative of the best practice in tool construction, and can be used with excellent results.

Besides this equipment we also build a complete line of Steam Hammers, comprising Forge, Drop, Board Drop and Tilting Hammers in capacities up to the largest ever built. They are entirely dependable and are designed to operate continuously with the least attention.

Niles Cranes will be found to answer the various requirements of ship yard and dry dock, as they include Electric Traveling Cranes from 5 to 250 tons, and larger capacity, Gantry Cranes, Yard Cranes, Wall Cranes as well as Grab Bucket Hoists and Trolleys.

We also Build

PRATT & WHITNEY PRECISION MACHINE TOOLS

As originators of the systems of interchangeable manufacture, the line of Precision Machine Tools as developed in our Pratt & Whitney Shops is unequalled for accuracy and refinement. Many of the machines that go out under the Pratt & Whitney name are practically automatic in action and are designed to permit the accurate machining of intricate and delicate parts without requiring highly skilled attention.

We mention some recent additions to our line which are special and original with us; Automatic Milling Machines, Horizontal Automatic Profiling and Cam Cutting Machine, Vertical Shapers, Jig Boring Machines, Contour Cutter Grinder.

PRATT & WHITNEY SMALL TOOLS AND GAUGES

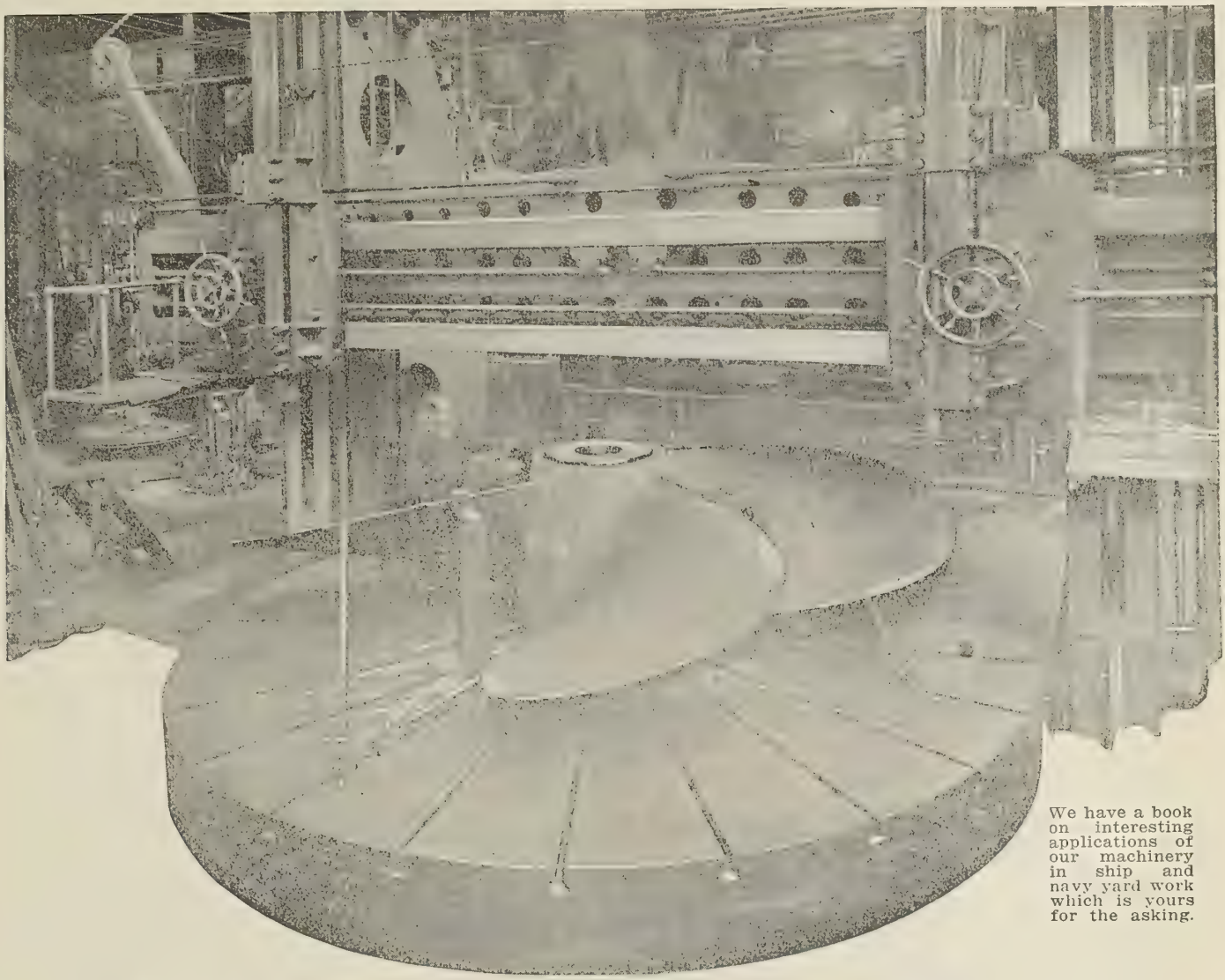
Pratt & Whitney Small Tools enjoy an enviable reputation for high quality that has been well earned in the high production shops of the country. In shipyards and railroad shops where stamina as well as accuracy are required of the small tool equipment, Pratt & Whitney tools have more than held their own.

We can honestly recommend them—our line is complete. Prompt service is assured at our nearest store, where P. & W. Small Tools are carried in stock for immediate delivery. Place your order there today. We will be glad to send you copies of our catalogues, "Small Tools," "Gauges and Standards."

OFFICES & AGENCIES: Boston—93-95 Oliver St. **Philadelphia**—405 N. 21st St. **Pittsburgh** — 325 Seventh Ave. **Cleveland, O.**—The Niles Tool Works Co., 730 Superior St. **Rochester**—116 South Ave. **Hamilton, O.**—The Niles Tool Works Co. **Cincinnati** — The Niles Tool Works Co., 338 W. Fourth St. **Detroit**—Kerr Bldg. **Chicago**—571 W. Washington Blvd. **St. Louis**—516 N. Third St. **Birmingham, Ala.**—2015 First Ave. **Los Angeles**—454 E. 3d. St. **San Francisco**—16 to 18 Fremont St. **Seattle**—1307 L. C. Smith Bldg. **London, Eng.**—25 Victoria St. S. W. **For Colorado, Utah, Wyoming and New Mexico** — Hendrie & Bolthoff Manufacturing & Supply Co., Denver. **For Canada** — The John Bertram & Sons Co., Ltd. Dundas, Montreal, Toronto, Winnipeg and Vancouver.

NILES-BEMENT-

GENERAL OFFICES,



We have a book on interesting applications of our machinery in ship and navy yard work which is yours for the asking.

Machining a Propeller for the "Leviathan"

THIS photograph of a N-B-P 34-Ft. Extension Boring and Turning Mill in the Philadelphia shops of the William Cramp and Sons Ship and Engine Building Co. is interesting in showing the class of work on which a great deal of our machinery has first call.

This mill, which has a capacity of 20 to 33 feet bored diameter, by 15 feet height of bore, is being used on a Parsons' Manganese Bronze Propeller for the U. S. S. "Leviathan." Diameter of wheel, 16 ft. 6 in.; weight, 41,000 lbs.

Where work larger than the ordinary is to be handled, N-B-P machine tools are generally depended on to get it out.

POND COMPANY

111 BROADWAY, NEW YORK

PRATT & WHITNEY SMALL TOOLS IN STOCK AT

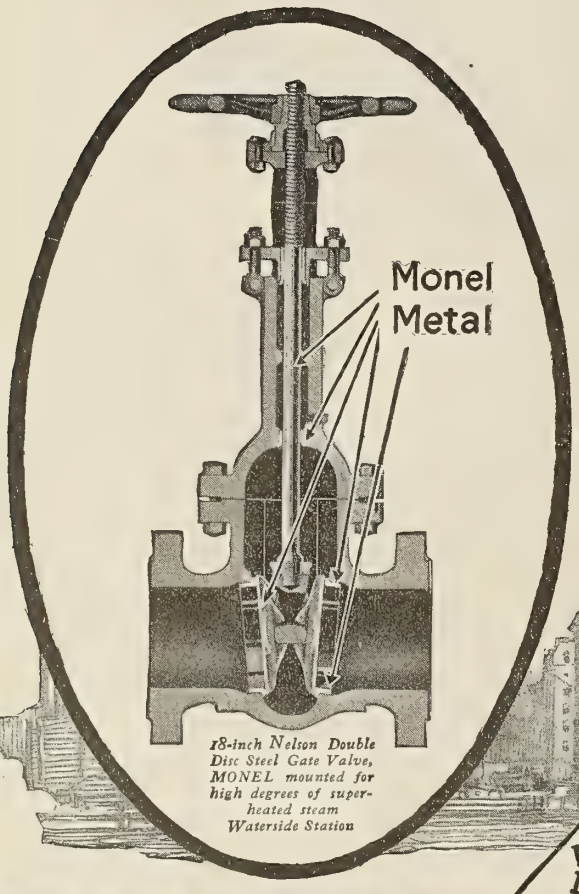
New York: 326 Hudson St. **Boston:** 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Cleveland:** 730 Superior St. **Detroit:** Kerr Bldg. **Chicago:** 571 W. Washington Blvd. **St. Louis:** 516 N. 3rd St. **Cincinnati:** 338 W. 4th St. **Birmingham, Ala.:** 2015 First Ave. **San Francisco:** 16-18 Fremont St. **New Orleans, La.:** C. T. Paterson Co., Ltd. **St. Paul, Minn.:** Robinson Cary & Sands Co. **Canada:** Pratt & Whitney Co. of Canada, Ltd.: Dundas, Montreal, Toronto, Winnipeg and Vancouver.

Place Your Order Today

Maintaining New York Edison Service with Valves, Pumps and Condensers fitted with

Monel

INCo



18-inch Nelson Double Disc Steel Gate Valve, MONEL mounted for high degrees of superheated steam Waterside Station

Waterside Station The New York Edison Company

INCo MONEL METAL TRADE MARK

THE INTERNATIONAL NICKEL COMPANY

metal

Uninterrupted Electrical Service

THE New York Edison Company has put MONEL Metal to a variety of uses in valves, pumps and other parts of its Water-side station equipment where resistance to wear and corrosion is of paramount importance in the operation of this efficient power plant.

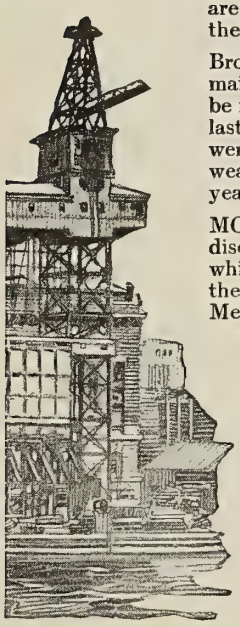
Practically all the main valves handling superheated steam are equipped with MONEL Metal seats; those that are not so equipped are being fitted with MONEL as rapidly as the seats wear out.

Bronze stems for controlling valves on the main turbines corroded and scaled and had to be replaced in two or three years. Steel stems lasted but a short time. MONEL Metal stems were tried and after two years' service show no wear or corrosion and are good for many more years.

MONEL Metal is also used in the suction and discharge valves in the step-bearing pumps which pump cold water at 1400 lbs. pressure—the hot well pumps are equipped with MONEL Metal rods—MONEL Metal bolts, nuts and washers are used in the condensers and wherever salt water conditions exist. MONEL is giving exceptional service wherever it has replaced other metals in this plant.

MONEL Metal is a natural alloy of nickel and copper — non-corrodible — strong as steel — tough and ductile. Withstands acids, alkalies, high temperatures and erosive action of hot gases and *superheated steam*. Can be cast, forged, rolled, machined, drawn, soldered, brazed and welded by electric or oxy-acetylene method. Takes and retains a perfect nickel finish.

MONEL Metal is manufactured in the form of rods, castings, wire, strip stock, sheets, etc. Some of its common uses, other than valve trim and pump rods, are pump liners; spark plug electrodes; aeroplane parts; mine screens; pickle pins; marine fittings; oil, gas and refrigerating machinery; dyehouse and dairy equipment and screw machine products. The MONEL booklets show the many uses for which MONEL Metal has proved superior.



Twelve years' experience in MONEL Metal is at your service through our Sales or Technical Department. Write us as to whether MONEL Metal could replace with greater satisfaction the material you are now using.

The International Nickel Company
43 Exchange Place New York, N. Y.

INCO NICKEL TRADE MARK

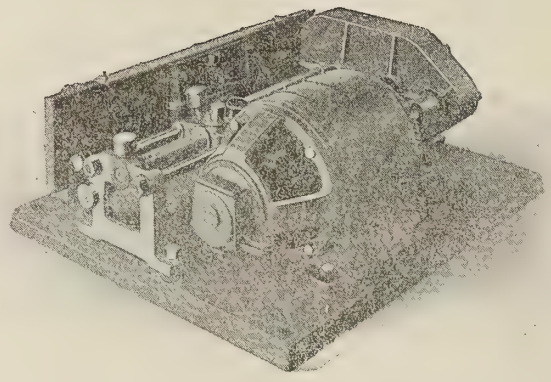
THE INTERNATIONAL NICKEL COMPANY

A Great



Benson
Electric Telemotor

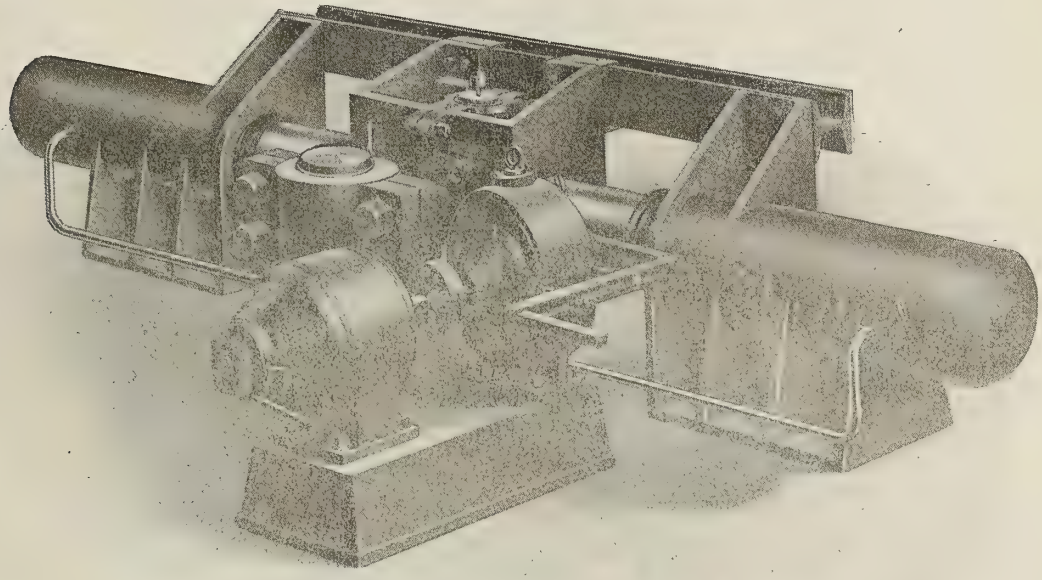
In fact it is rightly called "the Ideal Combination." The Benson Electric Telemotor is simple, positive and instant in operation. Not affected by air pockets or temperature changes. Always ready to work, practically fool-proof, absolutely accurate, low in running expense.



THE AMERICAN ENGIN

PHILADELPHIA,

Combination



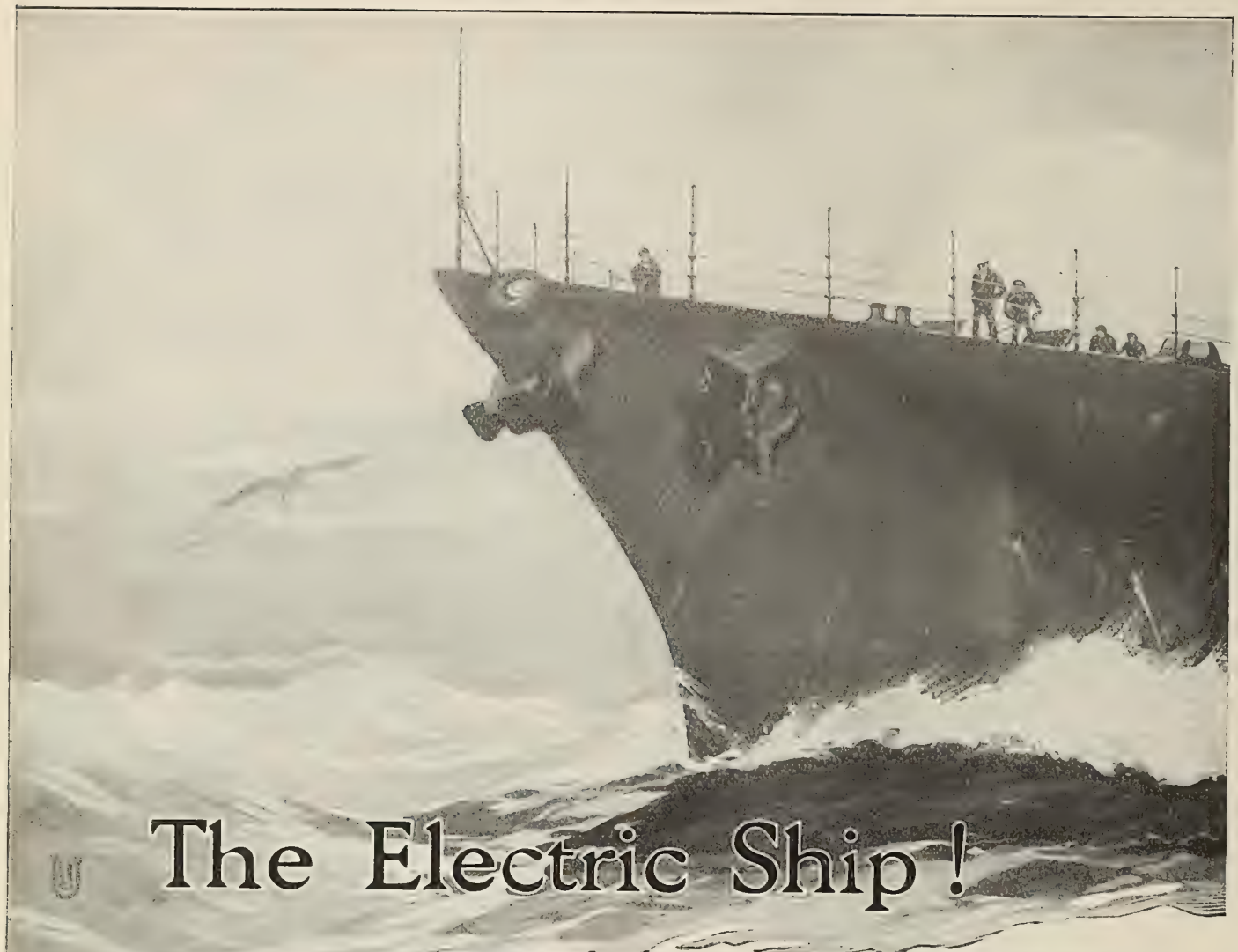
The American Electro-Hydraulic Steerer

prompt and powerful in action, accurate, sensitive, great holding power with ample provision for relief and recovery in case of overstrain due to heavy seas, economical in operation, and can be built to meet any particular space requirements. In proportion to its size it is the most powerful steerer built.

You will be satisfied with the combination.

EERING COMPANY

PENNSYLVANIA



The Electric Ship!



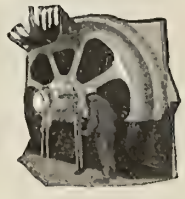
ELECTRIC drive for great ships became a fact with the successful trials of the New Mexico, flagship of the Pacific Fleet, the first battleship to be propelled by electricity.

"This engineering feat," says Secretary Daniels, "holds a peculiar interest to the people of the nation, especially when they realize that in this achievement the American Navy stands preeminent among the nations of the world. It marks an epoch in naval progress." It is another great advance in the mastery of the sea.

Ten years ago electric propulsion for vessels was being discussed by eminent engineers. But it remained for W. L. R. Emmet, consulting engineer of the General Electric Company, in co-operation with the Bureau of Steam Engineering, U. S. Navy, to apply it to large ships.

Five years ago electric drive was installed on the collier Jupiter, while one of her sister ships was equipped with geared steam turbine drive and another with direct-connected reciprocating engines. The results proved the unquestionable superiority of electric drive.

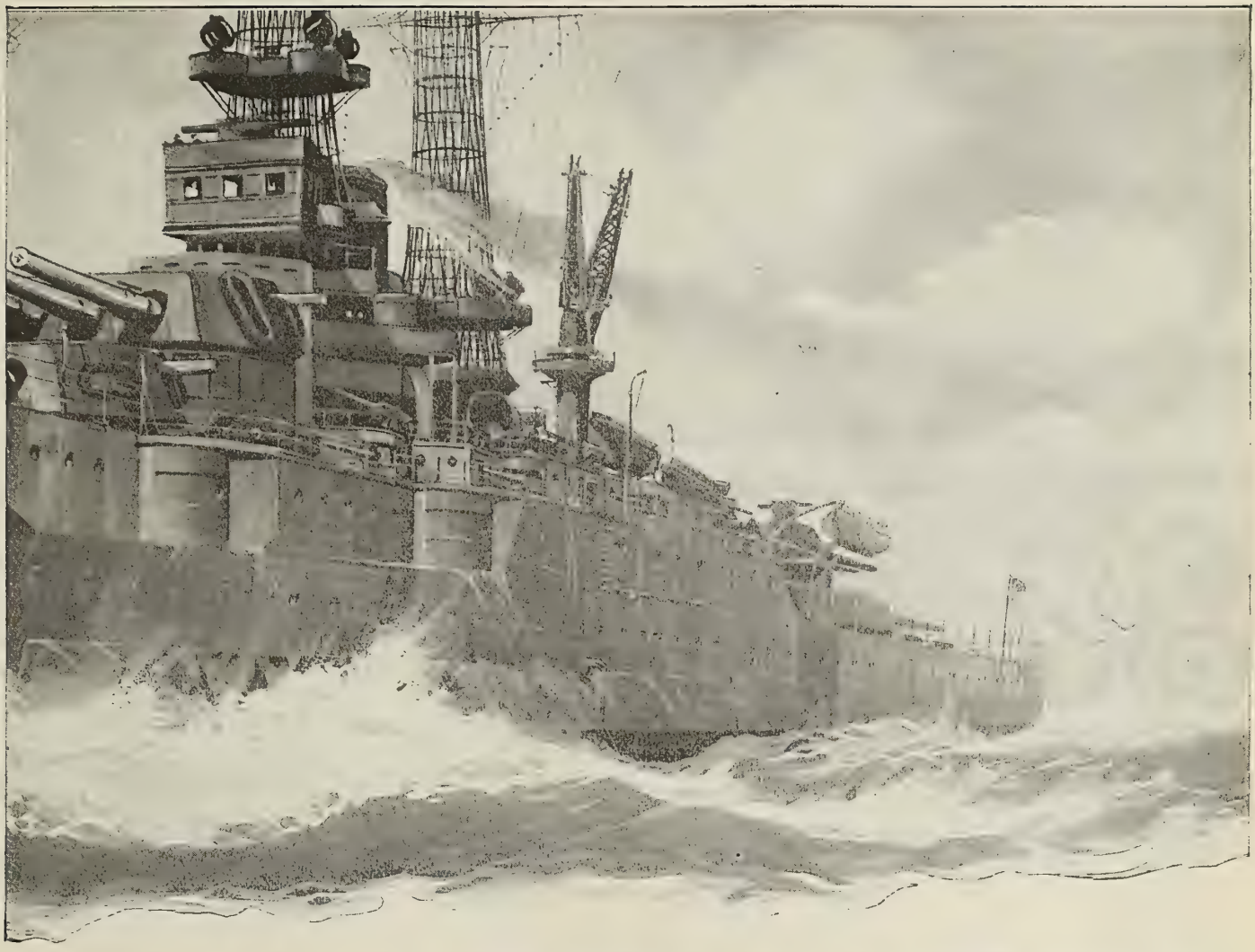
And so electric drive was adopted for the super-dreadnought New-



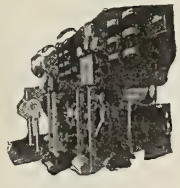
One of the four G-E 7000 horsepower electric motors—each on the end of a propeller shaft. They drive the New Mexico up to 21 knots, and can be reversed to full speed astern in thirty seconds.

Mexico, with 32,000 tons displacement and a speed of 21 knots. Steam from her oil-burning boilers drives two Curtis turbo-generators, which generate electric current and feed it through a central control to four 7,000 horsepower motors, each coupled to a propeller. Two thousand additional horsepower is generated for lighting, steering, turret machinery, ventilation, winches, windlasses, cranes, radio, telephony, searchlights, laundry, refrigeration, baking, machine shop—making the New Mexico an electric ship indeed!

GENERAL



As a result of the performance of the Jupiter and the New Mexico the United States Navy has adopted electric drive for all its capital ships now under construction or which have been authorized.



The operator of this control board—in the center of the ship—controls, through a few levers, the speed and power of the turbo-generavators and propelling motors, in immediate response to telegraphic orders from the bridge.

Its success in the Navy forecasts the rapid adoption of electric drive for merchant ships. In the case of any large ship now operating with reciprocating engines on long voyages, electric propulsion, if substituted, would afford enough improvement to pay for itself in three years.

Admiral Benson, until recently Chief of Naval Operations, says, "...as soon as the merits of this system become known commercially, electric propulsion will prove its practical value in the Merchant Marine just as thoroughly as it has to the Navy." He states that he regards "...electricity as the most economical motive power, from every viewpoint, so far developed for large units."

The chief advantages of electric drive are:

1. **Economy**—Fuel economy is not only apparent in the operation of electrically propelled ships, but decreased fuel storage room makes way for valuable cargo space.

2. **Reliability**—Electric propelling machinery has no motion other than simple rotation. Its simplicity in transmitting power from turbine to propeller eliminates the trouble caused by large reciprocating parts or multiplicity of reduction gears.



Two of these 14,000 horsepower Curtis turbo-generators, singly or together, produce current for any or all of the four motors.

3. **Flexibility of Installation**—Electric motors may be placed in the stern, instead of amidships, greatly reducing the length of propeller shafts and shaft alleys. The turbines can be near the boilers in compact quarters, doing away with many feet of steam piping, and adding valuable space. The power is transmitted the electric way—through small cables. The control can be in any convenient place, even on the bridge.

4. **Safety**—Electric drive gives vastly greater safety than the old types, because each unit can be isolated in its own water-tight compartment. In collision or other accident the throwing of a switch disconnects a damaged motor or shaft, and in the case of more than one propeller, the power is transmitted to the remaining propeller.

The building of electric propulsion machinery for ships of the Navy and Merchant Marine is but one of the many activities of the General Electric Company in its service to the Government, to transportation, to industries, to science, to cities and to the home.

An illustrated booklet describing the New Mexico, entitled, "The Electric Ship" will be sent upon request. Address General Electric Company, Desk 30, Schenectady, New York.

E L E C T R I C

When writing to advertiser, please mention INTERNATIONAL MARINE ENGINEERING.

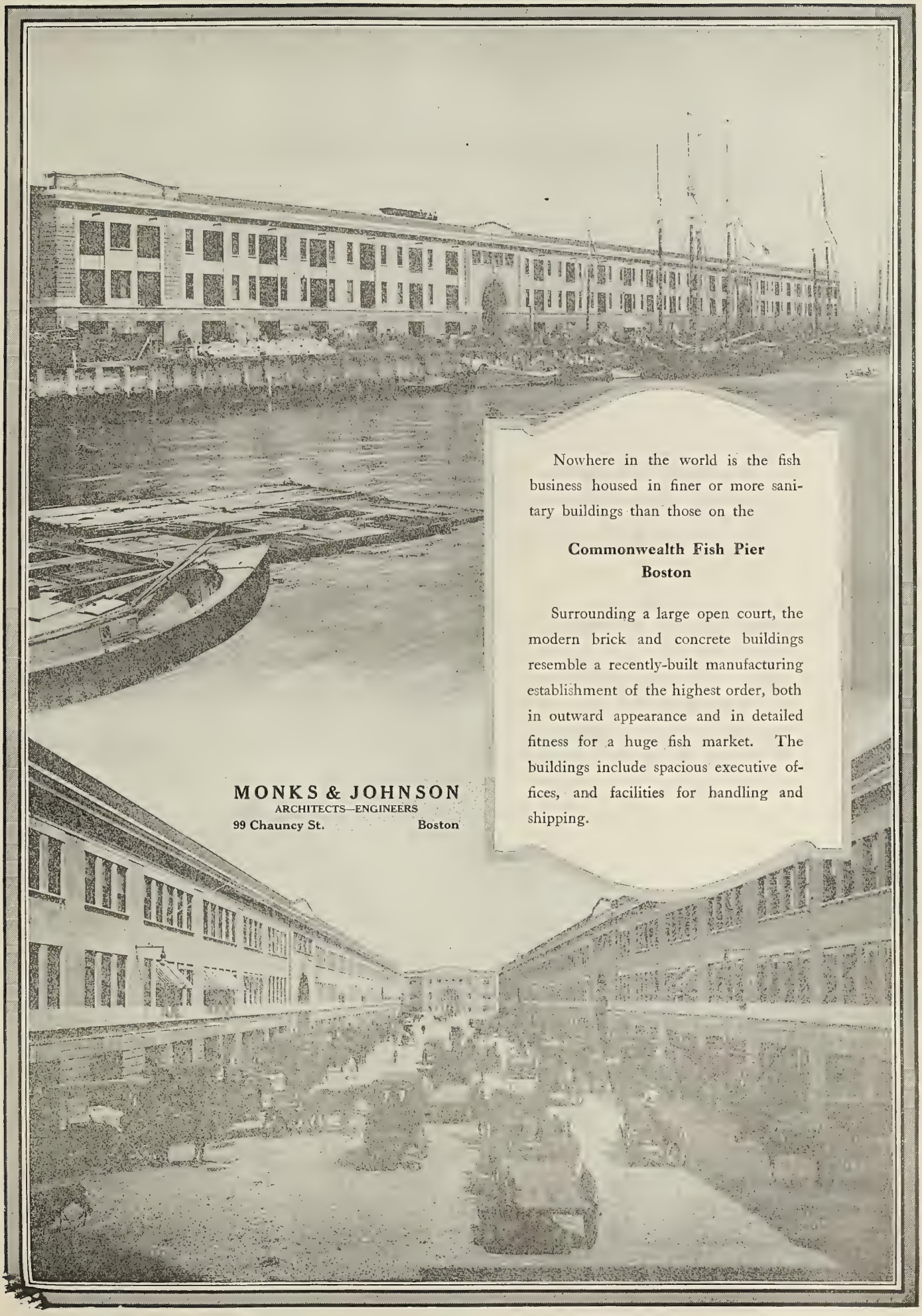
Use Red Cross Christmas Seals

BRUNSWICK ICE MACHINES

BRUNSWICK REFRIGERATING CO.

Marine Department

NEW BRUNSWICK NEW JERSEY



Nowhere in the world is the fish business housed in finer or more sanitary buildings than those on the

Commonwealth Fish Pier
Boston

Surrounding a large open court, the modern brick and concrete buildings resemble a recently-built manufacturing establishment of the highest order, both in outward appearance and in detailed fitness for a huge fish market. The buildings include spacious executive offices, and facilities for handling and shipping.

MONKS & JOHNSON
ARCHITECTS—ENGINEERS
99 Chauncy St. Boston

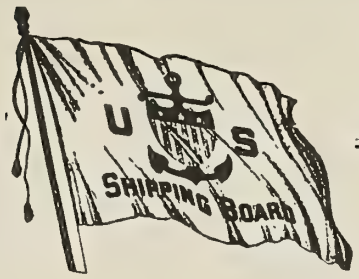


Motor Boats in the port of Cebu, P. I. Total 1750 H. P.—of which 1580 H. P. are "C-O" Oil Engines

The "Bukid" shown above is one of twenty-two vessels in Cebu that are powered with Fairbanks-Morse "C-O" oil engines. She is 60' long, 15' wide, draught loaded 8' 9", speed 8 knots—powered with two 45 H. P. "C-O" Engines. Other "C-O" powered vessels in Cebu range from the "Vicente" a 42 footer with a 30 H. P. "C-O" to the "Sadie"—a 150 foot boat with two engines of 100 H. P. each. On some of these boats—former steam vessels—the "C-O" fuel oil economy has cut operating cost to one-fourth of former cost—from 15 to 30 tons more cargo space is available—and former money losers are now making liberal profits. Let our Sales Engineers give you facts and figures that show why the most efficient and economically operated work boats—in each industrial fleet—from icebound coasts to torrid bays—are powered with Fairbanks-Morse "C-O" Marine Oil Engines.

Fairbanks, Morse & Co.
MANUFACTURERS CHICAGO

Engines - Pumps - Motors - Hoists - Air Compressors - Fairbanks Scales - Sheffield Motor Cars - Standpipes - Coaling Stations - Etc.



United States Shipping Board Emergency Fleet Corporation

Offers For Sale

116 Steamship Hulls 5 Sailing Vessels 61 Converted Barges

Wood Construction of the following Type and Tonnage:

Steamship Hulls	Converted Barges	Sailing Vessels
108 *Ferris*, 3850 t.	55 *Ferris*, 3550 t.	2 *Kirby*, 2000 t.
4 *Gray's Harbor*, 4300 t.	3 *Hough*, 4400 t.	3 *Ferris*, 3850 t.
2 *Geary*, 5000 t.	2 *Allen*, 3850 t.	
2 *Hough*, 4300 t.	1 *Continental*, 1600 t.	

Price Bare Hulls

Ferris Type, $75,000 Other Types, $21.40 per D.W.T.

Any equipment now on hulls to be paid for in accordance with an appraisal under our standard bill of material.

Hulls Are Moored at:

Portsmouth, N. H.; Wilson's Point, Conn.; Hog Island, Pa.; Beaumont, Texas; Lake Union, Seattle, Wash.; Alameda, Calif.; Columbia Slough, Portland, Ore.; Coos Bay, Ore.

These hulls are in various stages of completion. Some finished, others on the ways, at various shipyards in the Atlantic, Gulf and Pacific Coasts, which permits the purchaser making changes to suit his requirements.

Built to requirements of American Bureau of Shipping or British Lloyd's Register they represent, at above price, extraordinary value. A temporary certificate of classification furnished with each vessel so far as constructed.

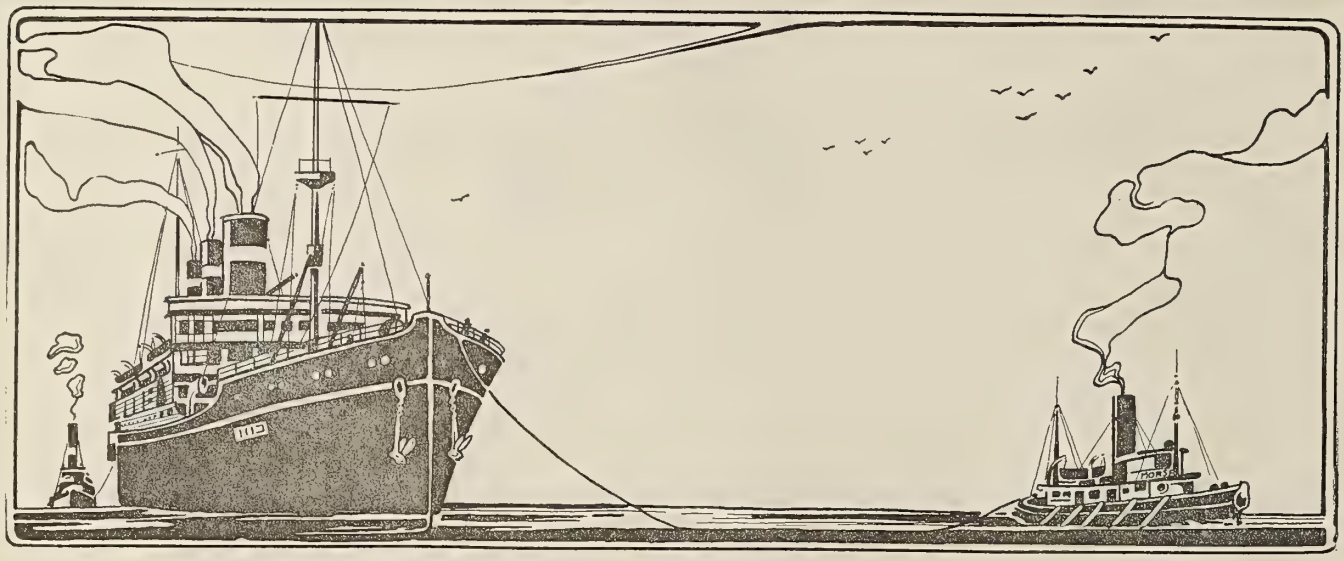
A complete equipment as specified in Bill of Material No. 500 for Ferris Hulls will be furnished on the basis of $100,000 for each vessel.

Further data may be had on application to Supply and Sales Division, United States Shipping Board Emergency Fleet Corporation, 140 N. Broad St., Philadelphia, or at any of the following district sales offices:

139 Centre St., New York City; Custom House, Boston, Mass.; 140 N. Broad St., Phila., Pa.; Hibernia Bank Bldg., New Orleans, La.; 922 Edison Bldg., Chicago, Ill.; Northwestern Bank Bldg., Portland, Ore.; Securities Bldg., Seattle, Wash.; 369 Pine St., San Francisco, Calif.

U. S. SHIPPING BOARD EMERGENCY FLEET CORPORATION

140 NORTH BROAD STREET, PHILADELPHIA



From the time a Morse Tug meets your ship, until the repairs are completed, Morse Service stands out---Unexcelled

Our estimators are prompt and careful in their work. You are assured courteous attention and a thorough, satisfactory repair job if you place your contract with us.

Morse service is speedy, reliable and efficient. We have a self contained plant with every facility for handling all classes of repairs and conversions.

The largest sectional floating dry dock in the world is here. It can raise a vessel of 30,000 gross tonnage and 725 feet long. An ordinary tramp steamer can be lifted in 18 minutes. Our No. 1 dry dock has a capacity of 15,000 tons.

A reliable fleet of our own ocean-going tugs and ice breakers, dredges, welding barges, floating machine shops and other special harbor craft is at your disposal.

A new heavy marine forge shop capable of turning out iron, steel and alloy forgings to suit every requirement up to 70,000 pounds is ready for operation, situated in a network of railroads and served by Morse lighters. There are no delays due to shipments.

Whether your boat is crippled, barely able to make port, or merely needs a new coat of paint, get our figures on the job if you want first class, efficient and skilled workmanship. If you are not already acquainted with Morse Service, you should be, and this is the opportune time.

The following departments are complete organizations within our own yard, ready to serve your particular need:

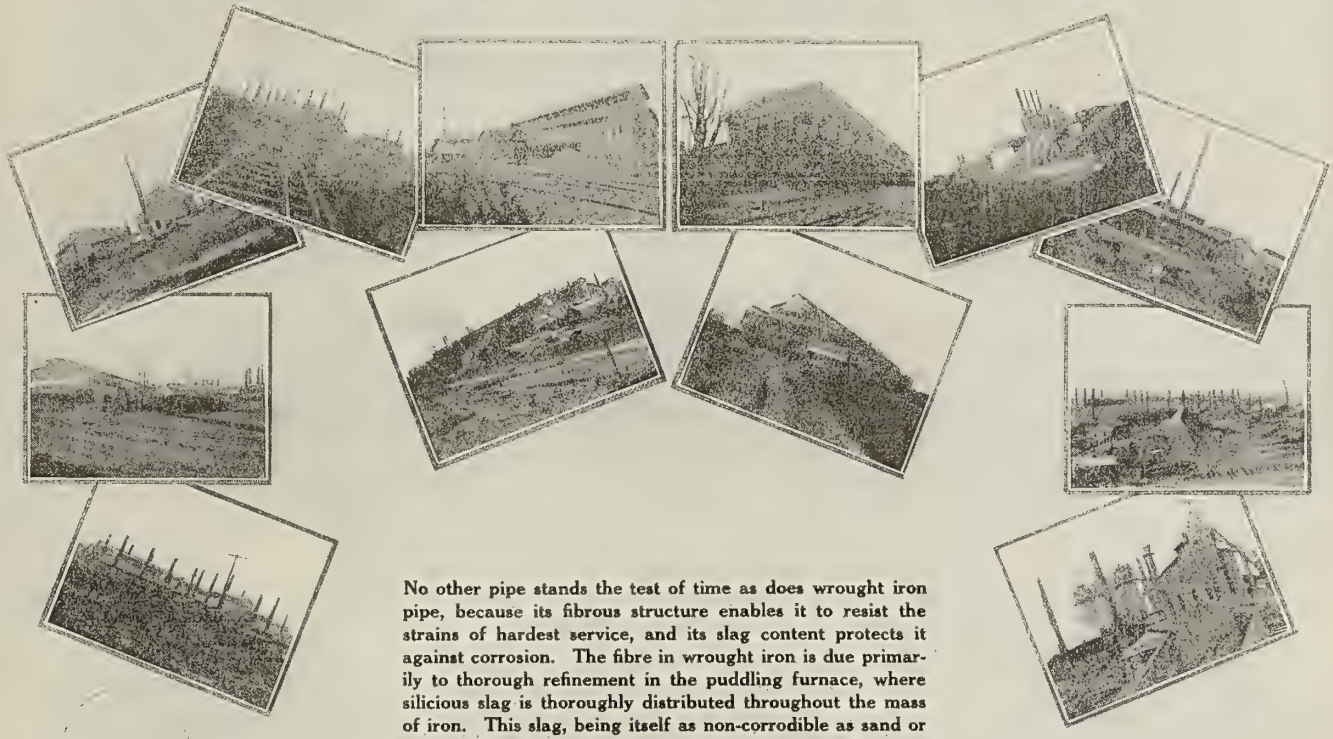
Boiler making and repairing, pipe fitting, pipe covering, plumbing, electrical work, copper smithing, sheet metal work, machinists, complete wood working departments, painting, wood caulking.

MORSE DRY DOCK & REPAIR CO.

Telephone Sunset 5100

Ft. of 54th to 57th Sts., Brooklyn, N. Y. Cable Address: Pyrosison, N.Y.

READING
WROUGHT IRON PIPE



No other pipe stands the test of time as does wrought iron pipe, because its fibrous structure enables it to resist the strains of hardest service, and its slag content protects it against corrosion. The fibre in wrought iron is due primarily to thorough refinement in the puddling furnace, where silicious slag is thoroughly distributed throughout the mass of iron. This slag, being itself as non-corrodible as sand or porcelain, multiplies the life of the iron wherever it is exposed to the corrosive effects of moisture or acid.

The fourteen plants of the Reading Iron Company are today producing America's largest output of wrought iron pipe. They are equipped with modern machinery, manned by skilled workmen, directed by executives responsible for the development of the most advanced methods of pipe manufacture.

The Reading Iron Company, alone among manufacturers of wrought iron pipe, controls its entire production from the great blast furnaces which make its own pig iron to the modern shipping platform where huge magnet cranes daily load tons of the finished pipe upon cars destined for every section of the country. With seventy-one years of experience in the field, with modern mechanical equipment, and with twice the capacity of any other manufacturer of wrought iron pipe in the world, the Reading Iron Company is in a position to render unusual service to users of pipe who seek quality and economy through years of satisfactory service.

READING IRON COMPANY

READING PENNSYLVANIA

As electric power and light have become integral parts of industrial and domestic life, so will electric heat become an immediate member of that same family.



For Example

WE now offer for your approval a highly efficient—simple—portable

Electric Rivet Heater

which practically eliminates all of the objections found in present methods.

Briefly the advantages of this new device are as follows:

1. No time wasted in starting production.
2. Heats very rapidly—heated five hundred $\frac{1}{2}$ in. x $1\frac{1}{4}$ in. rivets in one hour.
3. Better regulation of heat—energy only used when heating rivets.
4. Clean—***no smoke*** or ***gas formed.***
5. Quality of heat better and minimum of scale formed. Rivet heats from inside out, giving more uniformity of heat and better upsetting conditions in shank.
6. Wastage of rivets reduced to a minimum.
7. Portable, self-contained, economical and easy to operate.

Any additional information on this subject will be gladly forwarded you upon request.

General Electric Company

General Office Schenectady, N.Y.

39-13



Monterey Keeps Air Tools on the Job —It's Light, Strong and Oil-Resisting

The stout-bodied fabric of Goodyear Monterey Air Hose is steadfast assurance against kinks, cracks and bursts.

The high-grade, resilient rubber of Goodyear Monterey resists the rotting action of oil and provides the easy flexibility of a natural expansion and contraction under the recurrent pressures of the air.

Together—new, live rubber and long, tough fibre, firmly compacted in Goodyear special wrapped construction—they provide in Goodyear Monterey an air hose superior as to non-porosity, light in the hands of the workman, and successfully resistant to abrasion.

The wearing qualities of Goodyear Monterey, and its high operating efficiency, reduce its slightly higher first cost to an element of genuine economy.

Goodyear Monterey comes in 25- and 50-foot lengths.

THE GOODYEAR TIRE & RUBBER CO.
Offices Throughout the World

BELTING · PACKING · HOSE · VALVES

GOODYEAR

The Canadian Westinghouse Company Installed Thirty-Five Carloads of Equipment to Enable them to Store Safely, Measure Accurately,

distribute quickly, economically and with the least amount of waste, all of the oils and other liquids used in their mammoth plant.

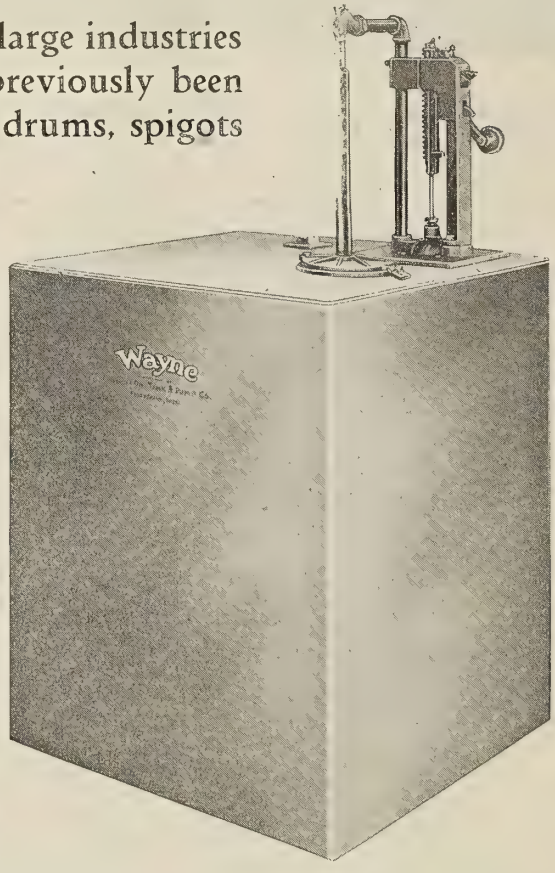
This order was placed after the most rigid investigation of modern oil and liquid storage systems as compared with the wooden barrel, steel drum and tin can measure system then in use.

Westinghouse engineers selected and have used since 1913,

Wayne

OIL STORAGE SYSTEMS

This order is but one of many received from large industries whose oil and liquid storage problem had previously been wastefully handled by wooden barrels, steel drums, spigots and tin can measures.



Practically every industry in the Marine Engineering Field uses oil and other liquids. You can effect a saving in your consumption and handling of these liquids.

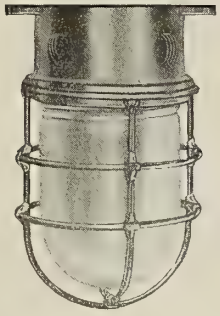
The present price of oils and other essential liquids, together with the price of labor should prompt you to take advantage of our free consulting service. Our engineering staff is at your service and will make a thorough investigation of your problem without any semblance of obligation.

Send for our complete catalogue. Write us telling about your present storage methods and oil consumption. Ask for Bulletin 35 ME.

Wayne Oil Tank and Pump Company

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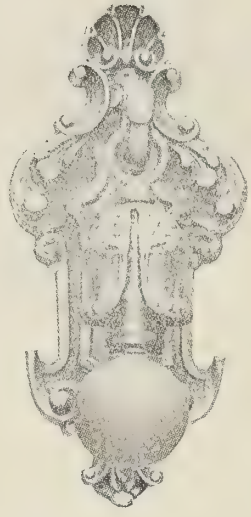
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ALSO

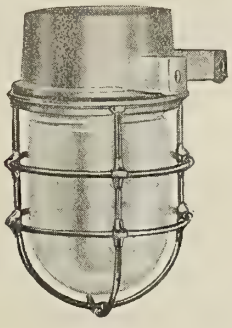
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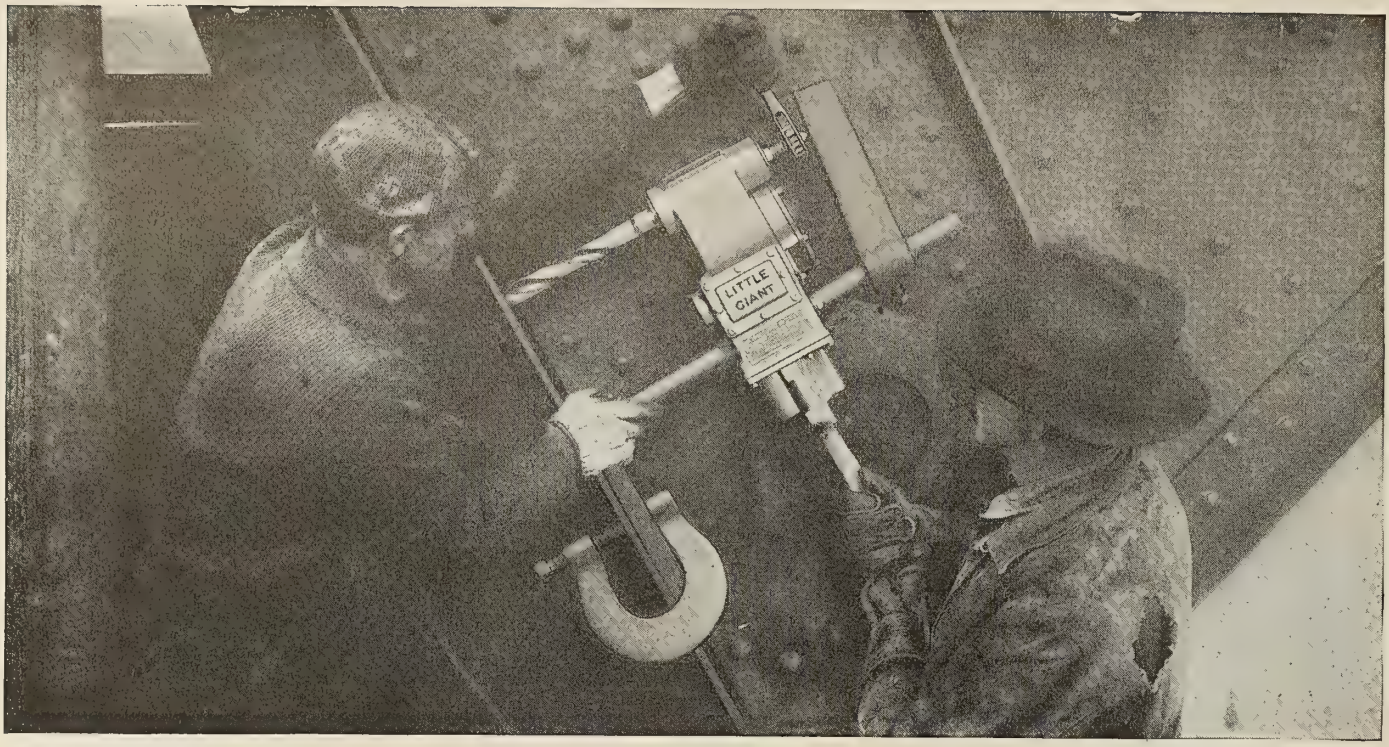
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ON REQUEST







ARLINGTON, N. J.



LITTLE GIANT

"Close Quarters" Air Drills

FOR drilling, reaming or tapping in end walls, corners, etc., the "close quarters" drill has proved itself a real necessity. Indeed, this type of drill at first designed for special application, is becoming generally recognized as an easy-to-handle, powerful drilling machine for general purposes.

In the new line of Little Giant Close Quarters Drills the power of the motor is transmitted to the spindle through a compact train of gears, thus providing for steady, uninterrupted rotation. There are no ratchet levers to cause reduced drilling speed, vibration, uneven pull, or wear and tear on the machine itself. The rugged stub-tooth gears employed are of special alloy steel, practically indestructible. Highest grade roller bearings insure further durability and operating economy.

Faster drilling, even speed, vibrationless operation, and reduced operating cost — are some of the main features of this recent addition to the "Little Giant" family of portable drills. Several styles are available, both reversible and non-reversible types.

Ask for complete information

Chicago Pneumatic Tool Company

1024 Fisher Building, Chicago, Illinois

Branches all over the world

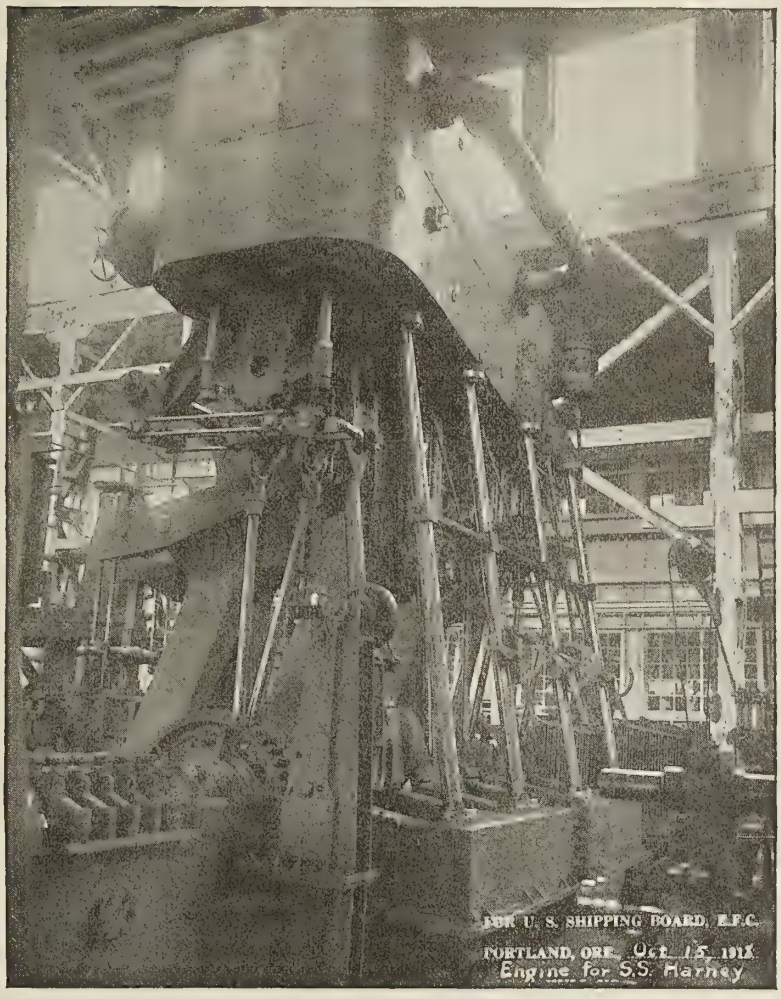
Birmingham	Cincinnati	Eldorado	Joplin	Minneapolis	Pittsburgh	Salt Lake City	St. Louis	Bombay	Havana	Christiania	Montreal	Seoul	Toronto
Boston	Cleveland	El Paso	Los Angeles	New York	Portland	San Francisco	Tucson	Brussels	Honolulu	London	Osaka	Sydney	Vancouver
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BOYER PNEUMATIC HAMMERS · ROCK DRILLS COAL DRILLS — LITTLE GIANT PNEUMATIC TOOLS · LITTLE GIANT ELECTRIC TOOLS

LITTLE *Pneumatic* GIANT *Tools*

P-21

CHICAGO PNEUMATIC AIR COMPRESSORS AND VACUUM PUMPS — GIANT FUEL OIL, GAS, GASOLINE AND STEAM ENGINES



ONE OF TWELVE 1,800 H. P. ENGINES BUILT FOR THE

EMERGENCY FLEET CORP'N.

BY

PACIFIC MARINE IRON WORKS

PORTLAND, ORE.

Engineers, Boilermakers, Machinists, Manufacturers of Ballin Water Tube Boilers

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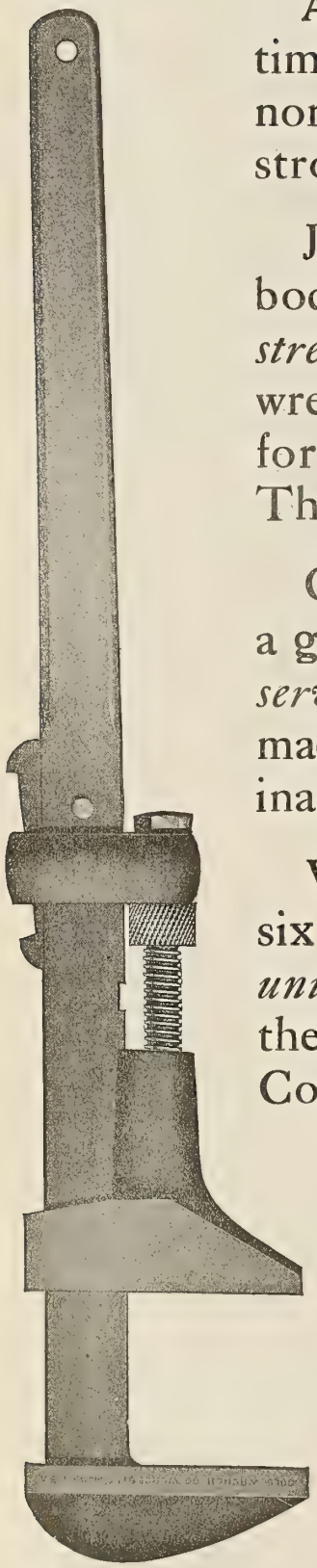
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12,000 TON DRY DOCK with all necessary equipment.

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The Importance Of a Strong Constitution

3 Sizes
28"-36"
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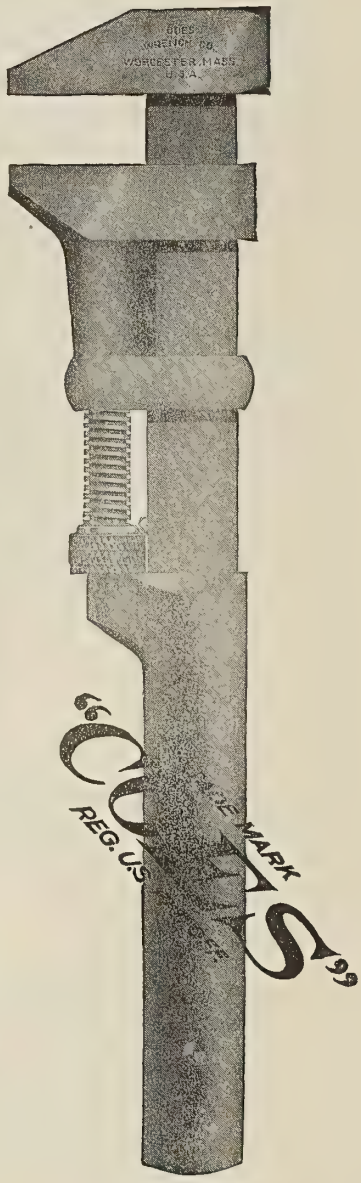


A man who is sick most of the time cannot accomplish much—nor a wrench, *both* must have a strong constitution.

Just as each part of the human body must contribute its share of *strength*, so must each part of a wrench *unite* with the other parts for this same accomplishment. There must be no *weak parts*.

Coes "Steel-Handle" Wrench is a good example of how *strong* and *serviceable* a screw wrench can be made when *useless* parts are eliminated.

With a constitution made up of six solid, simple whole parts, all *united* by the strong Coes method, there isn't a sign of weakness in a Coes Steel Wrench anywhere.



COES
"Steel-Handle"
WRENCH

7 Sizes
6" to 21"

These two models are especially made for trying service, in moisture, (hot or cold) and for heavy duty.

Coes Wrench Company

Established 1841 in
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J. H. GRAHAM & CO., 113 Chambers Street, New York
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For Continental Europe

SYMBOLS *of* SERVICE



Never before in the history of the Red Cross was its glorified service so greatly appreciated by mankind as it was during the world war. True, the Red Cross has always in times of peace and war followed floods, fires and other disasters in order to alleviate human suffering. Yet the world never fully comprehended until the war came that the Red Cross is a revelation of service idealized.

The war showed, too, the value of service commercialized. Such service can also be earnest and far reaching and beneficial to mankind. The Government demanded in spite of need for haste that materials be true to specifications; yet real worth remained to be proven by the test of time. Those firms which, during the war, gave such genuine service, have therein learned the lesson of service for all time to come.

The house of the Marine Decking & Supply Company is founded on the principle that the service of its products is the only commodity that it has to offer for sale. The successful service that these products have given in the past proves that this principle is sound for the future.

LITOSILO DECKING

MADESCO BITUMINOUS SOLUTION & ENAMEL

MARINE DECKING & SUPPLY CO. PHILADELPHIA, PA. MADESCO PRODUCTS

MADESCO WOOD AND STEEL BLOCKS

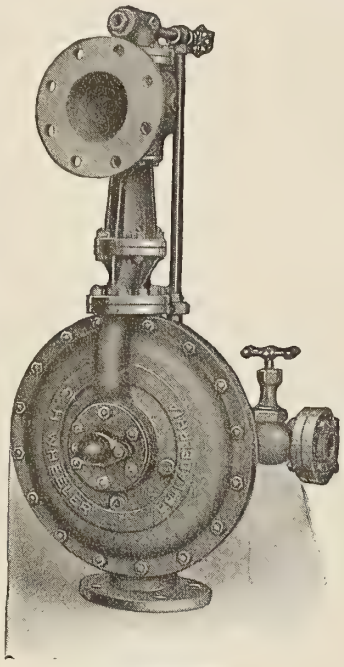
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We Specialize in the Design and Construction of Surface and Jet Condensers.



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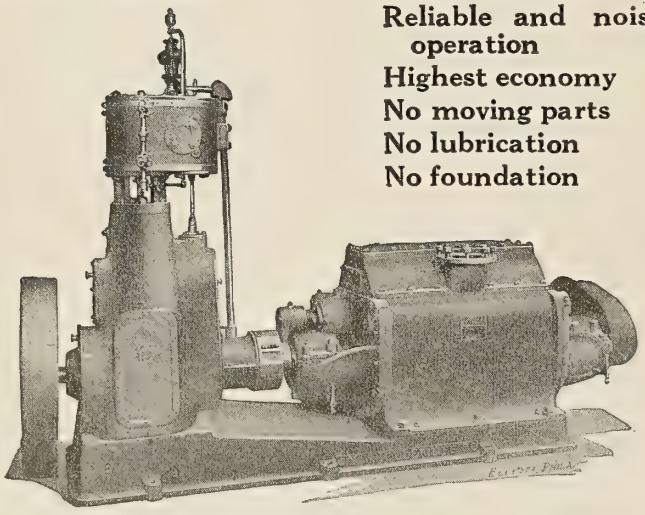
28.8 to 29.3" vacuum when operating under full load conditions.

RADOJET AIR PUMPS

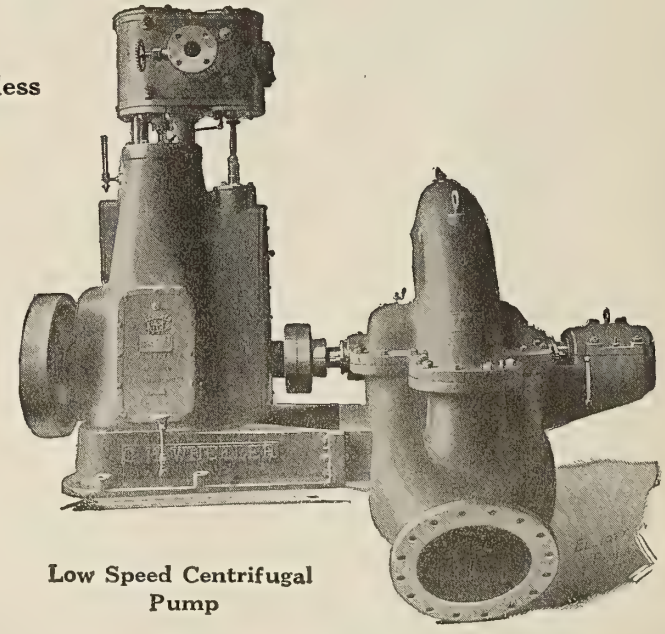
Fulfill all the requirements for marine service.

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No foundation

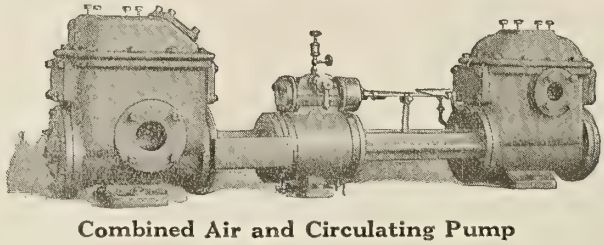
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ROTREX Vacuum Pump



Low Speed Centrifugal Pump



Combined Air and Circulating Pump

C. H. WHEELER MANUFACTURING COMPANY

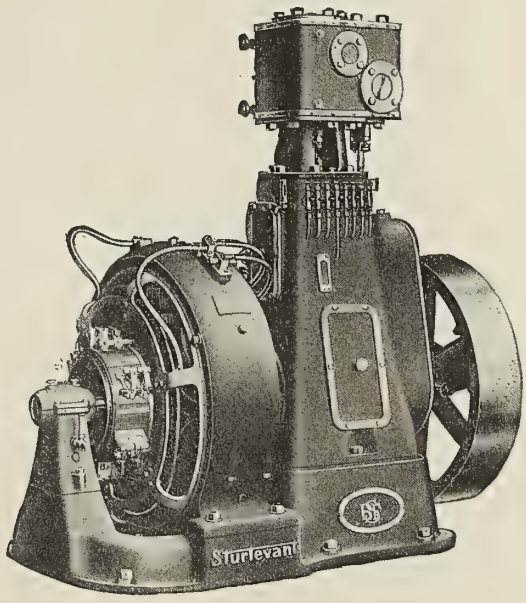
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Electric Generating Sets



Designed and Built To U.S. Navy Specifications!

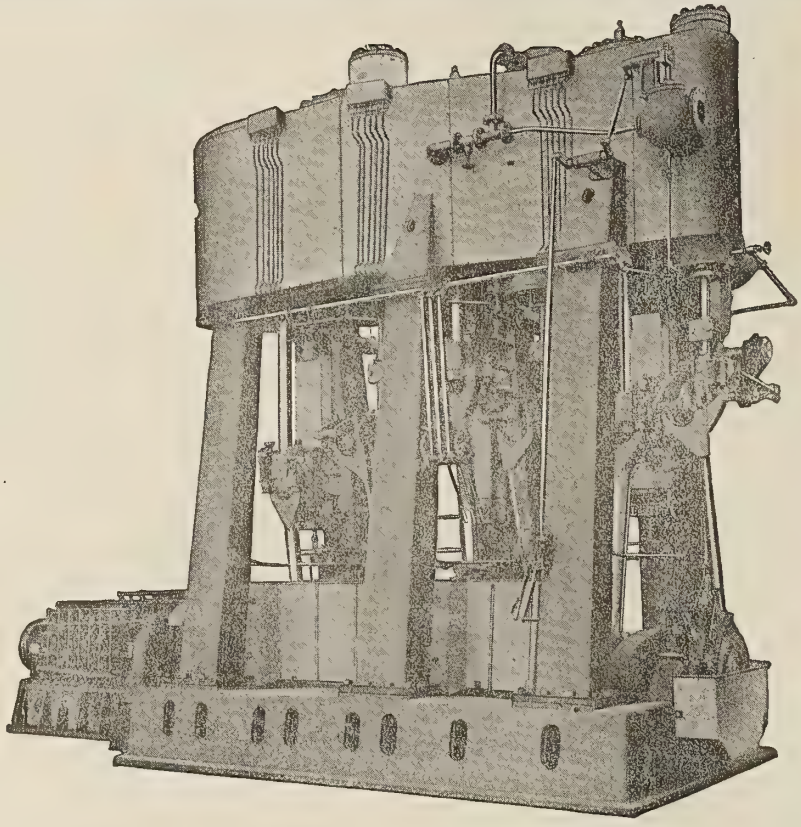
—which fact forcibly indorses their efficiency, design, dependability, and quality of construction. Have close regulation and are suitable for all light and power purposes. Specially adapted for isolated power plants, and as auxiliaries in large plants, as well as on shipboard. They are compact, self-contained units, consisting of a Sturtevant steam engine direct connected to a conservatively rated Sturtevant electric generator. Are made with automatic lubricating systems, either gravity or forced feed. All reciprocating parts of the engine are entirely enclosed within the engine frame, which is provided with oil- and dust-proof covers. All parts are readily accessible by removing these covers. Write us for Bulletin No. 23911 which details the merits, design, and construction of Sturtevant Electric Generating Sets.

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Traylor's exceptional manufacturing and shipping facilities insure Quickest deliveries of

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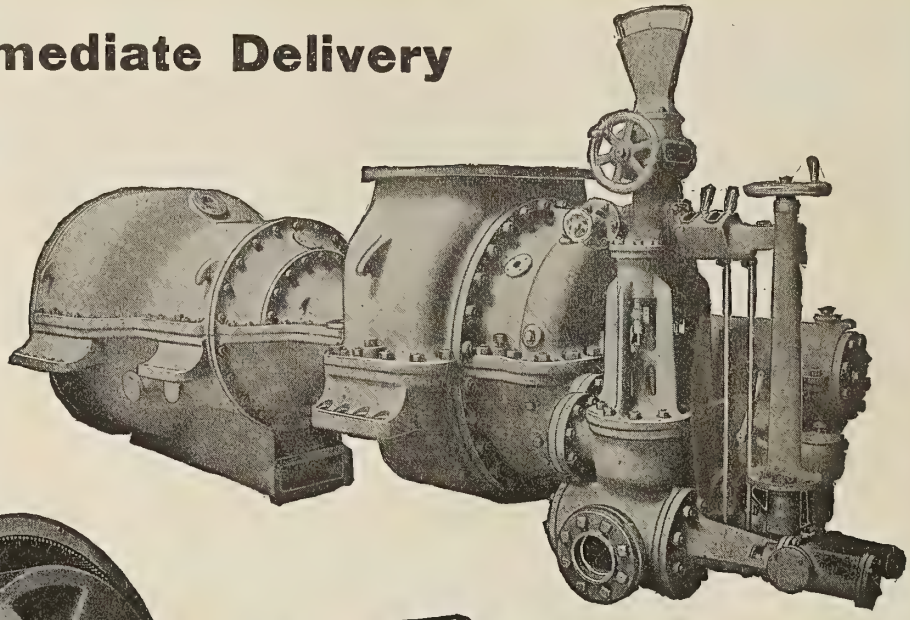
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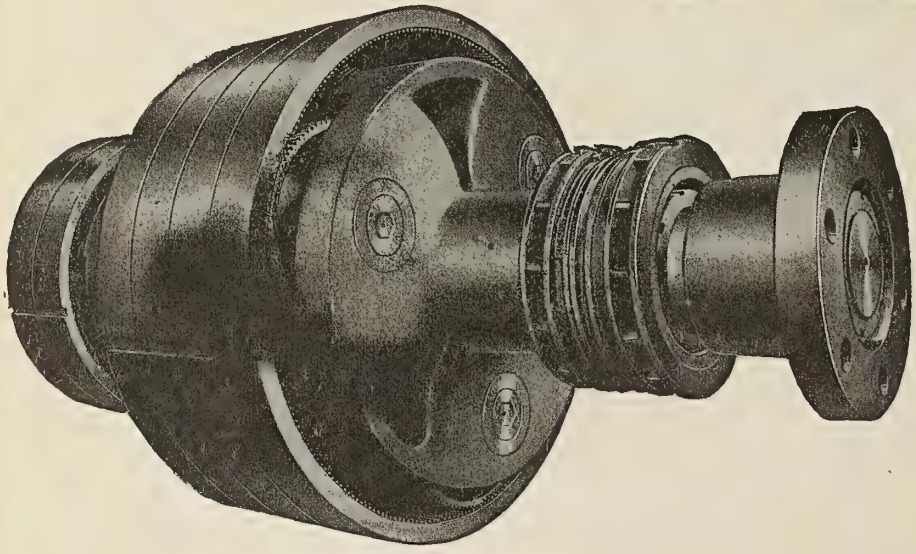
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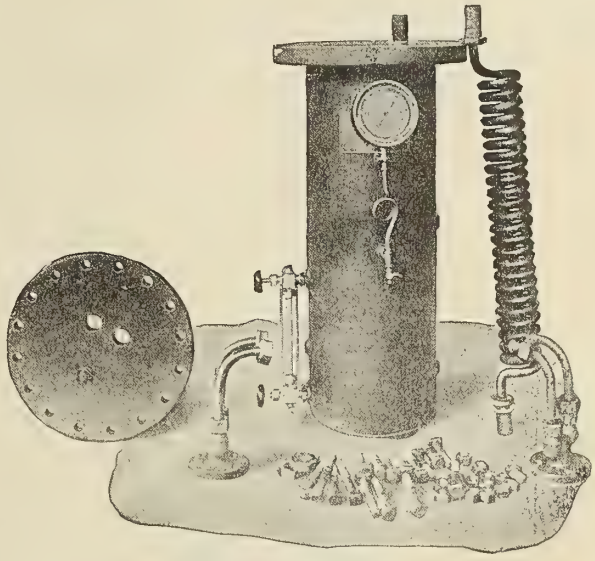
WORKS, BALTIMORE, MD., U. S. A.

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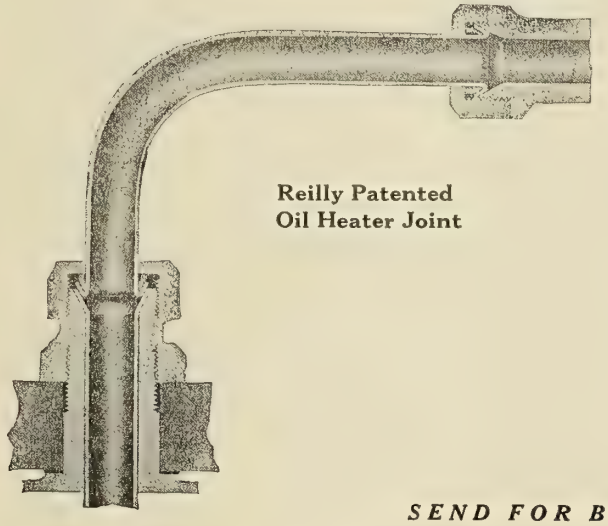
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This refers to units in actual operation or now on order and being built in our works. For use in U. S. Navy, Merchant Marine, and Stationary Power Plants.



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ADVANTAGES

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BOLINDERS



MOTORSHIP "KATHERINE"—Philippine Vegetable Oil Company's latest tanker. 286 ft. 9 in. x 43 ft. 5 in. x 24 ft. 1 in. Gross Weight 2196 Tons. Equipped with two 320 B. H. P. Type "MII" Bolinder Fuel Oil Engines. Speed eight knots.

Built to be the finest of its type—this ship is Bolinder Equipped.

MOTHORSHIP "Katherine," the latest addition to the fleet of tankers owned by the Philippine Vegetable Oil Company, has gained by her recent trial trips, the most enthusiastic praise of naval experts.

Originally a four masted, square rigged, British built, iron sailing ship, she has been converted into a six masted, bald headed auxiliary schooner with total cargo capacity of 3,000 tons on 22 ft. draft. The substantial workmanship throughout, the most modern and efficient installations, together with her splendid showing on her trial trip, has earned for this ship the highest classification in Lloyds.

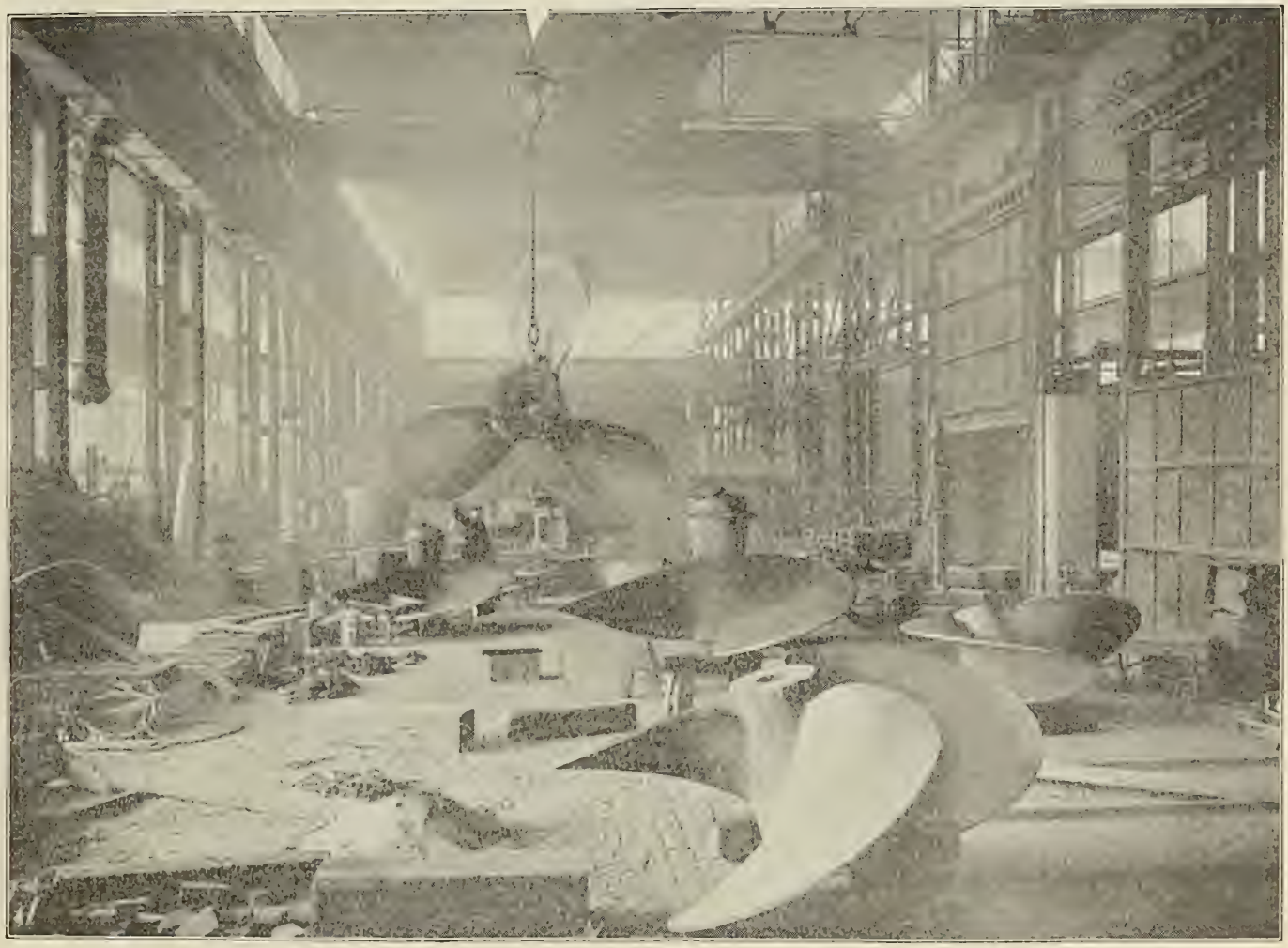
The Efficiency and Economy afforded the Philippine Vegetable Oil Company by BOLINDER ENGINES is likewise at your command.

BOLINDERS COMPANY, 30 Church Street, NEW YORK CITY

Pacific Coast Representatives—HENRY LUND & COMPANY, Marine Bldg., San Francisco, Cal.

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CRAMP



Center Bay of Cramp's Propeller Foundry

Showing in the foreground four propellers for destroyers, two with sinkheads and two with sinkheads cut off. Also showing at the extreme left one destroyer propeller at the saw, sinkhead being cut off. The large propeller held by the traveling crane is 16 feet 6 inches diameter, weighs 25,000 lbs. and was made for Bethlehem Shipbuilding Corporation, Fore River Plant.

The ladle in the left background holds 75,000 lbs. of PARSON'S MANGANESE BRONZE, of which metal the propellers are cast. Over 800 of these wheels for 400 transports, cargo and war vessels were turned out by the Cramp Company during the war. The Foundry cast 1,000,000 lbs. marine bronze castings per month as part of its war work.

THE WILLIAM CRAMP & SONS SHIP & ENGINE BUILDING COMPANY

PHILADELPHIA, PA.

STANDARD

For Forty Years



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Denmark	Nienstaed & Co., Copenhagen
Japan	The F. W. Horne Co., Tokyo

COLUMBIAN BRONZE PROPELLERS



Photograph by courtesy of Morse Dry Dock & Repair Co.

"Spica" illustrated above is a typical example of the type of boat now using Columbian Bronze Propellers in place of cast iron wheels.

Built in 1877 by Harland & Wolff as a steel Sailing Schooner. Converted in 1919 to a Motorship by the Morse Dry Dock & Repair Company and equipped with the Columbian Bronze Propeller illustrated in the right hand corner herewith.

"Spica" is 230 ft. x 36 ft. x 22 ft—1332 tons, now equipt as a motorship with a bronze propeller is a mighty efficient ship.

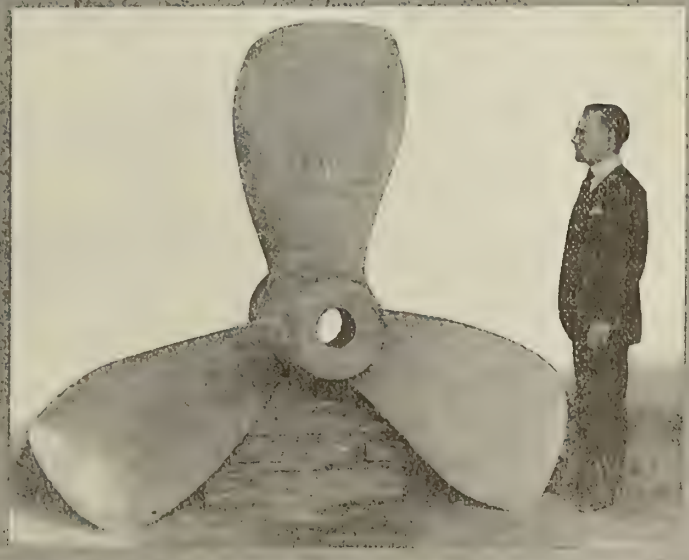
Your ships will be better ships, more dependable ships, more efficient ships if they are equipt with Columbian Bronze Propellers.

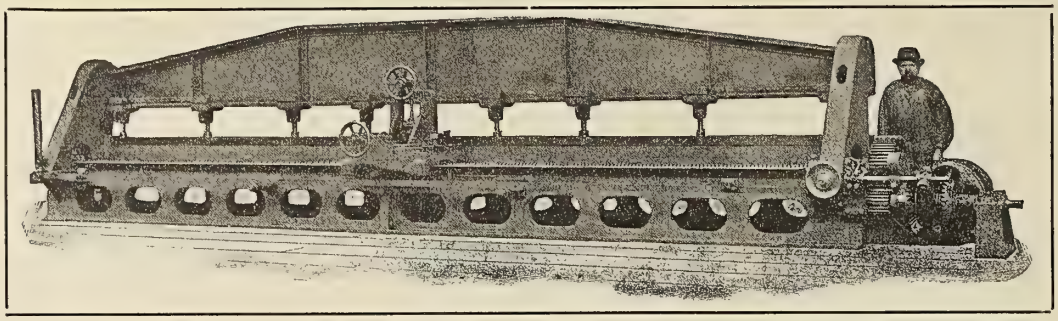
WE manufacture complete Steamship and Motor Ship Propeller Equipment including propellers; intermediate and tail shafts in bronze and steel up to 10" in diameter, in bronze up to 5"; shaft couplings; stern tubes; stern bearings, babbitted or lignum vitae lined—all to Lloyd's specifications where required, or to your specifications otherwise.

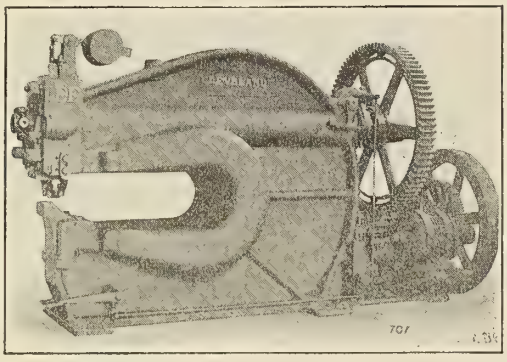
Write for the NEW Columbian Catalog —it's well worth having and it's FREE.

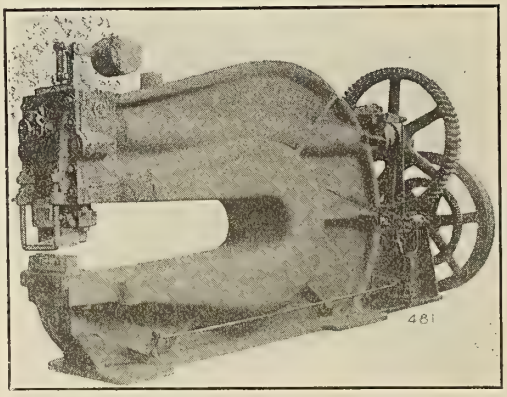
COLUMBIAN BRONZE CORPORATION

Executive Office: 50 Church Street, New York City









CLEVELAND

Whether the machine is a Plate Planer with a Bethlehem "I" beam for a clamping girder or a Punch or Shear with the SOLID semi-steel frame---every machine that bears the name of *"Cleveland"* is substantially constructed for continuous satisfactory service.

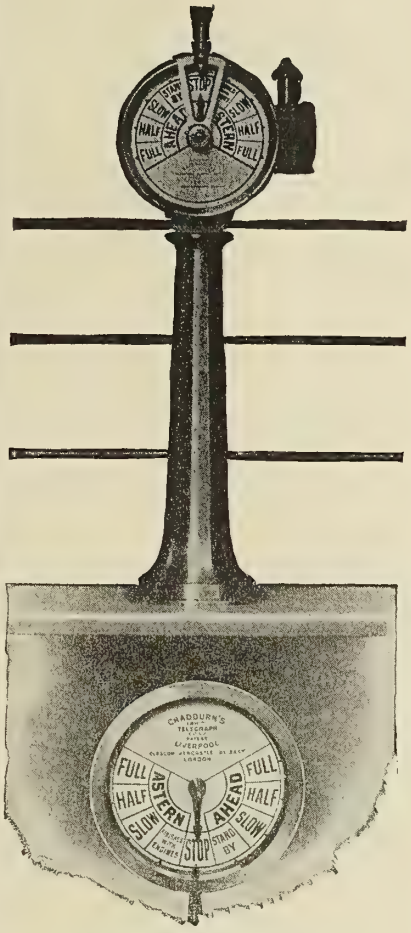
Cleveland Engineers carefully study the purpose for which a machine is designed and make ample provisions for stresses and shocks to which machines used in the fabrication of iron and steel are subjected.

Our thirty years' experience as manufacturers is at your disposal whenever you contemplate the purchase of any of the following:

Punches and Shears
Bending Rolls
Straightening Rolls
Rotary Planers
Straightening Machines
Multiple punches
Gate Shears
Radial Drills
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Plate Planers
Angle Shears

THE CLEVELAND PUNCH & SHEAR WORKS CO.
Main Office & Works · CLEVELAND, OHIO
PITTSBURGH - CHICAGO - PHILADELPHIA - NEW YORK

CHADBURN FOR SAFETY



Engine-Room Telegraph
Single Screw Equipment

CHADBURNS of England were the original inventors and patentees of all forms of ship's telegraphs, both Naval and Mercantile.

CHADBURN (SHIP) TELEGRAPH COMPANY OF AMERICA, Inc., is an American company formed to manufacture the whole of the Chadburn specialties for the United States.

The American company is producing telegraphs of every description for the fast growing Mercantile Marine of America, and their highly equipped factory at Troy, N. Y., is in a position to give expert advice regarding the most suitable forms of equipment required.

In addition, the American company is now manufacturing high-class Binoculars, Compasses, Sextants, Sounding Machines and Engine Counters.

Up to date over 12,000 vessels of the Mercantile Marine of all nations are carrying the Chadburn specialties exclusively.

CHABDBURN (SHIP) TELEGRAPH CO. of AMERICA

INCORPORATED

TROY, NEW YORK

Factries also at—Montreal, Canada, and Liverpool, England

ROLL CALL—1919

PURCHASER	No. of Cranes	Size—Tons
Allis-Chalmers Co	240	1 to 75
Bethlehem Steel Co	209	1 to 75
American Brass Co	168	¼ to 20
Standard Steel Works Co	96	5 to 40
Baldwin Locomotive Works	94	5 to 150
The Midvale Steel Co	82	½ to 150
U. S. Government	71	1 to 25
N. Y. Ship Building Co	68	5 to 60
Haskell Barker Car Co	66	1 to 12
Crucible Steel Co. of America	52	2 to 25
American Bridge Co	49	2 to 30
International Harvester Co	48	2 to 10
American Sheet & Tin Plate Company	47	2 to 50
American Clay Machinery Co	44	3 to 20
American Car & Foundry Co	43	1 to 10
Ford Motor Company	37	½ to 30
New Orleans Board of Port Commissioners	37	2 to 15
Worthington Pump & Machinery Corp	36	1 to 10
Pusey & Jones Co	35	3 to 30
The Falk Co	34	¼ to 40
Pennsylvania R. R. Co	34	1 to 50
American Locomotive Co	32	3 to 50
J. I. Case Threshing Machine Co	32	2 to 20
Wm. Cramp & Sons S. & E. B. Co	33	5 to 45
Ingersoll Rand Co	32	½ to 30
Chicago & Northwestern R. R.	31	2 to 75
McClintic Marshall Cons. Co	30	5 to 25
Pacific Lumber Co	30	3 to 5
Jos. T. Ryerson & Son	29	2 to 20
Illinois Steel Co	28	1 to 40
Baltimore Copper Smelt. & Roll. Co	27	3 to 15
Sun Shipbuilding Co	27	5 to 100
Fairbanks, Morse & Co	25	2 to 20
Westinghouse Mach. Co	25	3 to 20
Bettendorf Axle Co	24	2 to 10
Chile Exploration Company	24	2 to 30
The East Jersey Pipe Co	24	3 to 15
Milwaukee Elec. Ry. & Lt. Company	24	¼ to 125
The National Malleable Casting Co	24	1½ to 50
Chickasaw Shipbuilding Co	23	3 to 5
Reading Iron Co	23	3 to 10
Dodge Bros	22	1 to 10
Wheeling Steel & Iron Co	22	2 to 10
The Bucyrus Co	21	3 to 25
Rome Brass & Copper Co	21	½ to 2½
Tennessee Coal, Iron & R. R. Co	21	3 to 50
Studebaker Corporation	20	2 to 10
Calumet & Hecla Mining Co	20	1 to 25
Nordberg Mfg. Co	20	2 to 40
Phillips Sheet & Tin Plate Co	20	1 to 30
Sullivan Machinery Co	19	3 to 40
The Vilter Mfg. Co	19	2 to 20
American Smelting & Refining Company	18	3 to 25
Bullard Machine Tool Company	18	3 to 20
Lukens Iron & Steel Co	18	1½ to 20

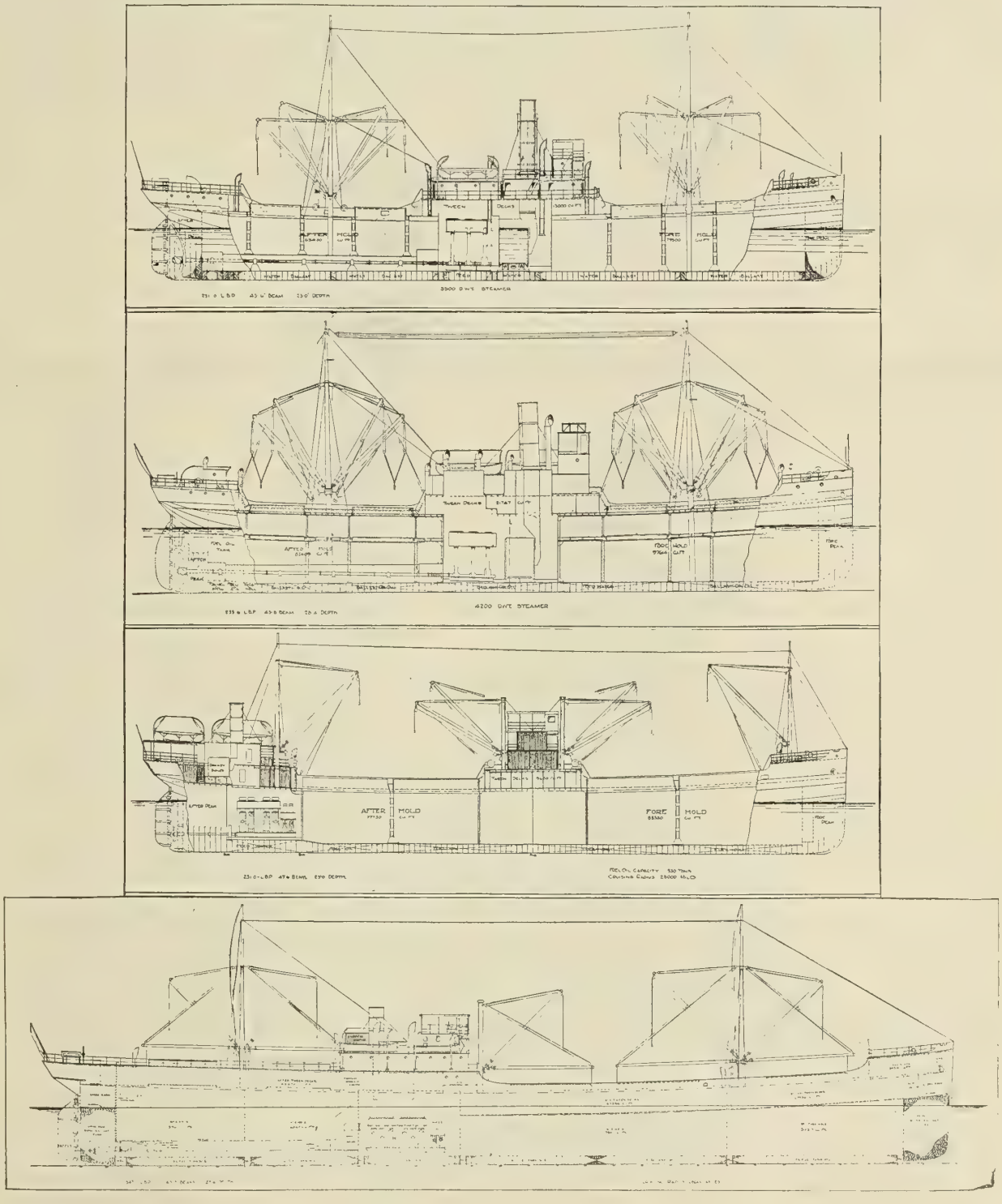
PURCHASER	No. of Cranes	Size—Tons
National Carbon Co	18	3 to 10
Oil Well Supply Co	17	2 to 15
Geo. H. Smith Steel Casting Co	17	½ to 10
Superior Steel Co	17	3 to 25
Federal Shipbuilding Co	16	2 to 5
Fulton Iron Works	16	4 to 30
Lorain Steel Co	16	5 to 30
Merchants Shipbuilding Co	16	3 to 15
Crane Company	15	1½ to 3
La Belle Iron Works Co	15	5 to 35
Minneapolis Steel & Mach. Co	15	5 to 30
National Brake & Elec. Co	15	3 to 20
Tremont Lumber Co	15	3 to 15
Goodman Mfg. Co	14	3 to 15
Gould Coupler Co	14	3 to 30
Texas Company	14	2 to 10
Follansbee Bros. Co	13	5 to 25
Milton Manufacturing Co	13	2 to 6
McConway & Torley Co	13	5 to 25
New Jersey Zinc Co	13	1½ to 40
Northwest Steel Co	13	5 to 15
Whitaker-Glessner Co	13	2 to 50
The Filer & Stowell Co	13	5 to 30
American Steel & Wire Co	12	½ to 30
Ball Engine Co	12	1½ to 25
Platt Iron Works	12	5 to 20
Lewis F. Shoemaker Co	12	4 to 10
Simmons Co	12	2 to 10
Dravo Contracting Co	11	3 to 15
John Eichleay Jr. & Co	11	2 to 20
Edward Ford Plate Glass Co	11	3 to 25
Heppenstall Forge & Knife Co	11	3 to 10
Mesta Machine Co	11	3 to 75
Newport Mining Company	11	1 to 20
Advance Rumely Co	11	5 to 20
Henry Vogt Machine Co	11	5 to 25
Belmont Iron Works	11	5 to 15
Jeffrey Manufacturing Co	11	3 to 25
Baltic Ship Building & Eng. Wks	10	3 to 35
Carnegie Steel Co	10	1 to 10
Firestone Tire & Rubber Co	10	2 to 15
Gisholt Mach. Co	10	5 to 10
Jones & Laughlin Steel Co	10	4 to 40
New York Edison Co	10	10 to 50
Norton Grinding Co	10	1 to 10
S. Morgan-Smith Co	10	5 to 15
Western Drydock & Shipbuilding Co	10	3 to 20
Camden Forge Co	9	10 to 25
American Shipbuilding Co	8	10 to 30
Fore River Shipbuilding Co	8	7½ to 50
Busch Sulzer Bros. Diesel Eng. Co	8	5 to 40
Standifer Construction Co	8	3 to 25
Lackawanna Bridge Co	8	5 to 20
Newport News Shipbuilding & D. D. Co	7	20 to 30
Oregon Railroad & Navigation Co	4	15 to 120

6000 CRANES IN USE

Built by
PAWLING & HARNISCHFEGER COMPANY, *Milwaukee*

P&H cranes-hoists-monorail systems

MANITOWOC SHIPBUILDING COMPANY



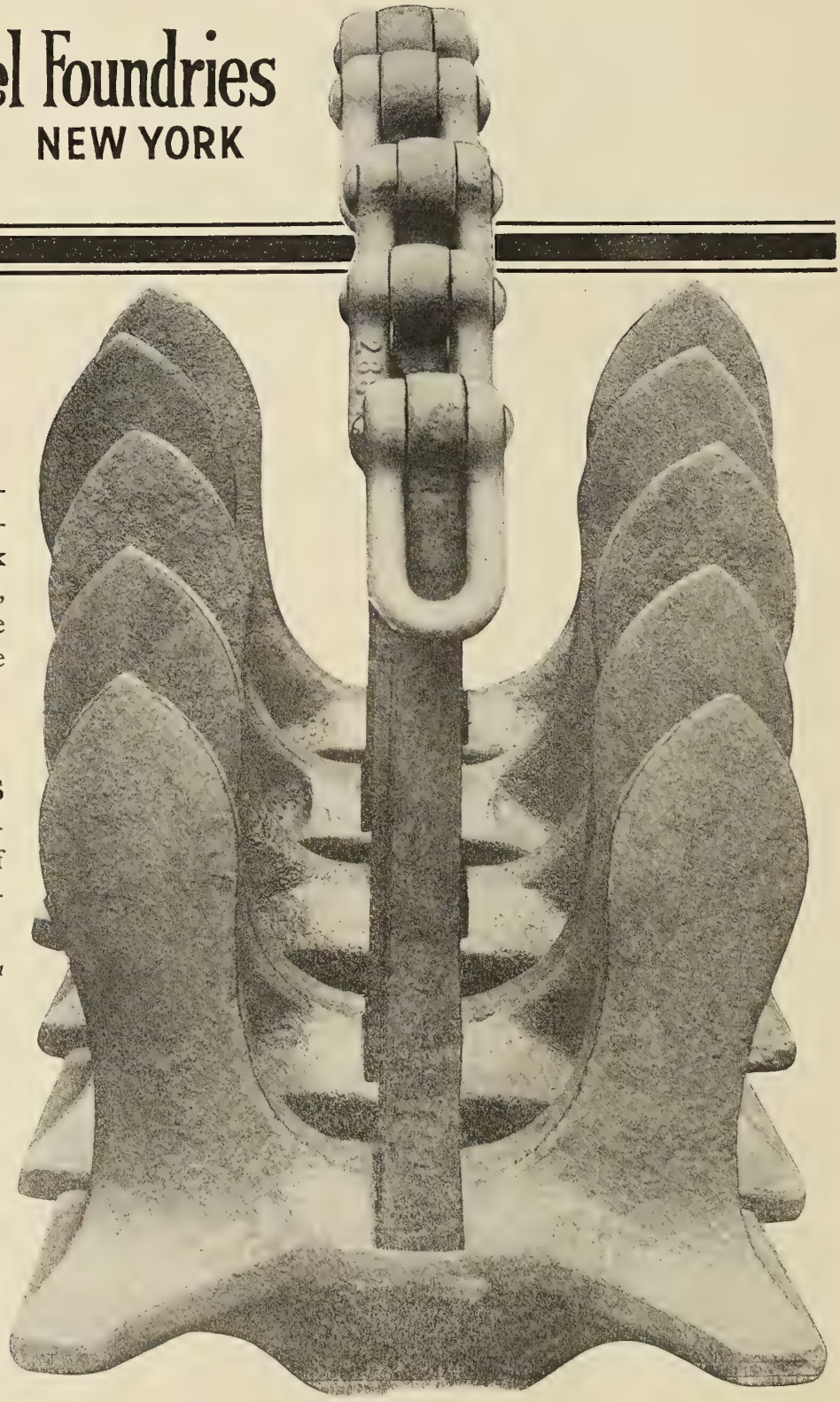
Standard ocean going steam and motor ships. Designers and builders of steel vessels. marine engines, boilers, ship auxiliary machinery, etc.

MANITOWOC, WISCONSIN

Dunn Stockless Anchors

American Steel Foundries

CHICAGO NEW YORK



Used on all classes of vessels from the largest battleships to small fishing smack—and in every instance, even under the most severe conditions, they have made good.

Dunn Stockless Anchors have unfailing holding power; eliminate all chance of fouling; are by far the easiest to operate.

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You may pay a little more per pound for Whitlock ALL-Manila Rope, because **we** pay more per pound for the fibre we use. **But**—

Your cost per **foot** is little, if any, higher,—often it is lower; and your work is done more cheaply because Whitlock ALL-Manila Rope has greater strength and **life.**

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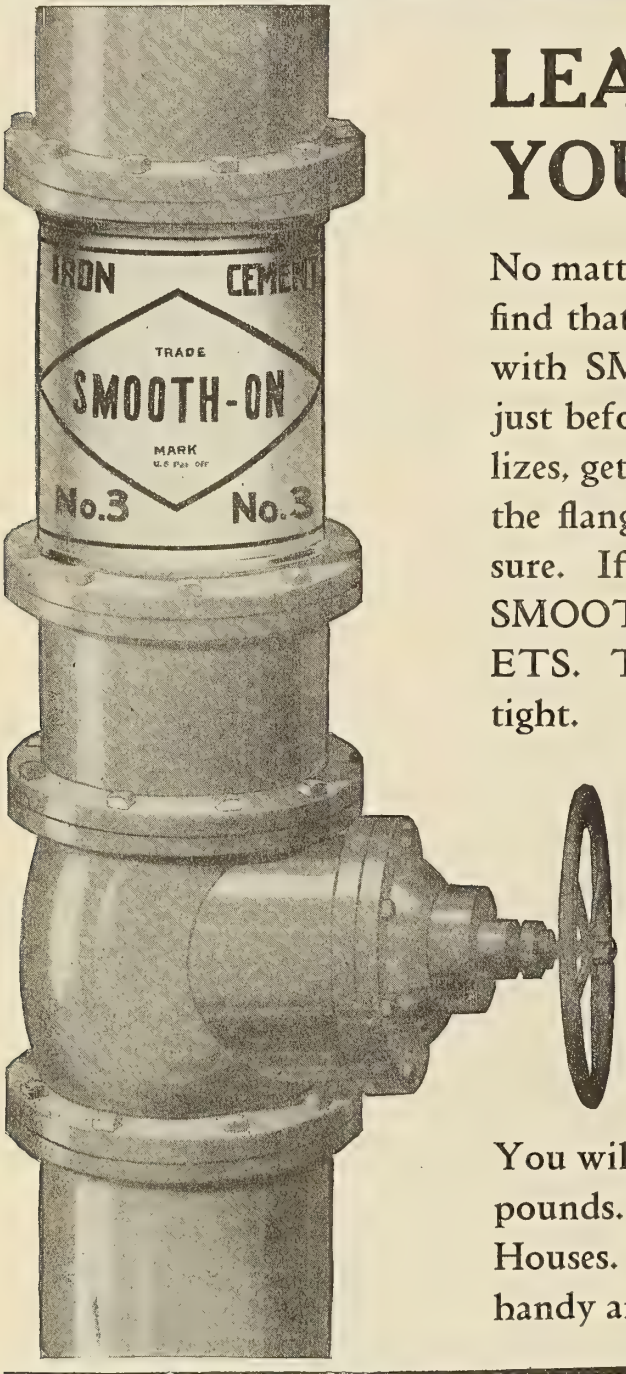
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SMOOTH-ON ELASTIC CEMENT No3



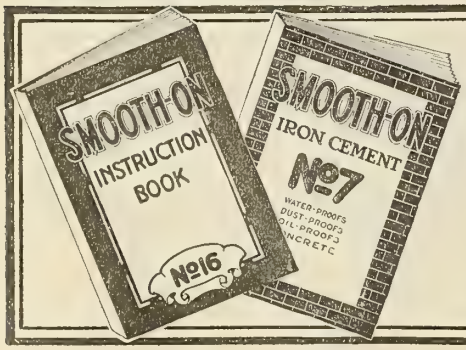
LEAK PROOF YOUR FLANGE JOINTS

No matter what kind of gaskets you are using you will find that they can be improved by coating both sides with SMOOTH-ON ELASTIC CEMENT No. 3 just before making the joint. It expands as it metallizes, getting right down into the little irregularities of the flange face, and making a tight joint absolutely sure. If you want the maximum in gasket value use SMOOTH-ON CORRUGATED IRON GASKETS. The line is yet to be found that they can't hold tight.

For Low Pressure Steam Lines

The highest priced packings cannot give better service than gaskets cut from manila paper and coated with SMOOTH-ON ELASTIC CEMENT No. 3. Try it.

Use SMOOTH-ON ELASTIC CEMENT No. 3 for screw thread joints too. You will find it far better than ordinary jointing compounds. Smooth-On Cements are sold by Supply Houses. The *five pound* cans are recommended as a handy and economical size.



We have two valuable books for Free Distribution. Send Postal or use Coupon. Smooth-On Instruction Book No. 16 with 144 pages of Power Plant data. Smooth-On Instruction Book No. 7 should be in the hands of every man with "dusting "and "damp-roofing" problems to solve.

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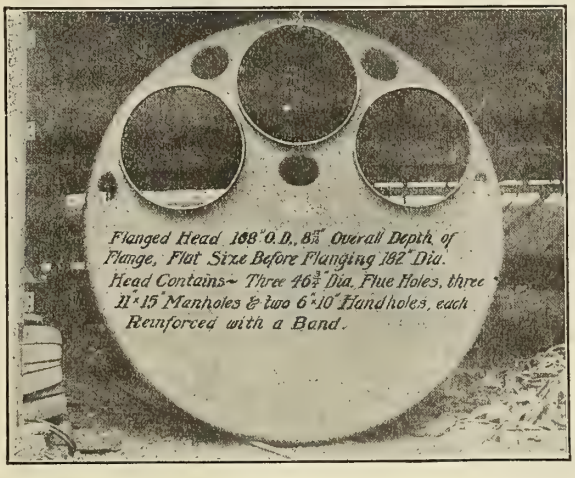
SAVE THE PIECES

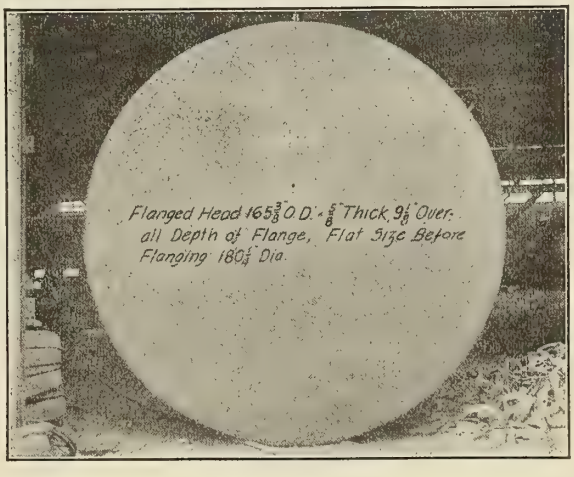
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The World's Largest Plate Mill

Since we started up our 204 inch mill you can build large Marine Boiler Heads in One Piece, also use one plate instead of two or more in Boiler Construction, thus avoiding unnecessary seams and rivets.

Design Boiler Heads in One Piece





Lukens Steel Company

Coatesville, Pa.

CONSOLIDATED STEEL CORPORATION, 165 Broadway, New York City, our sole representative in export trade. Send export inquiries to them.

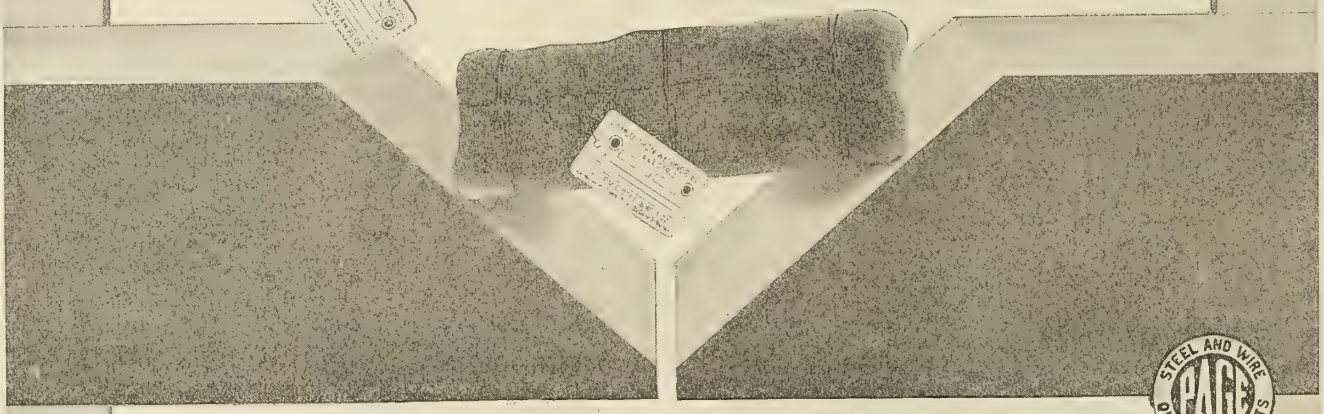
The *Guaranteed* Welding Wire

ARMCO IRON WELDING RODS

For Oxy-Acetylene Welding



For Electric Arc Welding



All authorities since the first application of oxy-acetylene welding have agreed that the best welds are secured by the use of Pure Iron.

ARMCO IRON is guaranteed 99.84% pure iron and is positively the purest commercial iron in the world.

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Therefore, ARMCO IRON Welding Rods flow freely, weld evenly, and lend themselves perfectly to finishing operations.

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STEEL AND WIRE PAGE QUALITY PRODUCTS

AMERICAN ARMCO INGOT IRON

PAGE STEEL & WIRE CO.

Established 1882 as Page Woven Wire Fence Co.

The trade mark ARMCO carries the assurance that iron bearing that mark is manufactured by the American Rolling Mill Company with the skill, intelligence and fidelity associated with its products, and hence can be depended upon to possess in the highest degree the merit claimed for it.

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CHICAGO: 29 South LaSalle Street DETROIT: Book Building

SAN FRANCISCO: American Rolling Mill Company of California

CANADIAN DISTRIBUTORS: Taylor & Arnold, Ltd., Montreal, Toronto, Winnipeg

AMERICAN BUREAU OF SHIPPING

(INCORPORATED 1862)

The Standard American Classification of Shipping

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GREAT LAKES DEPARTMENT

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This Bureau supervises the construction of vessels throughout under established rules, tests all materials for hulls, machinery and boilers, and proof tests all anchors and chains, etc.

Classification of a vessel is a standard for builders and owners and the certificate is an authority for underwriters and shippers.

Blackmer Marine Pumps are Universally Used

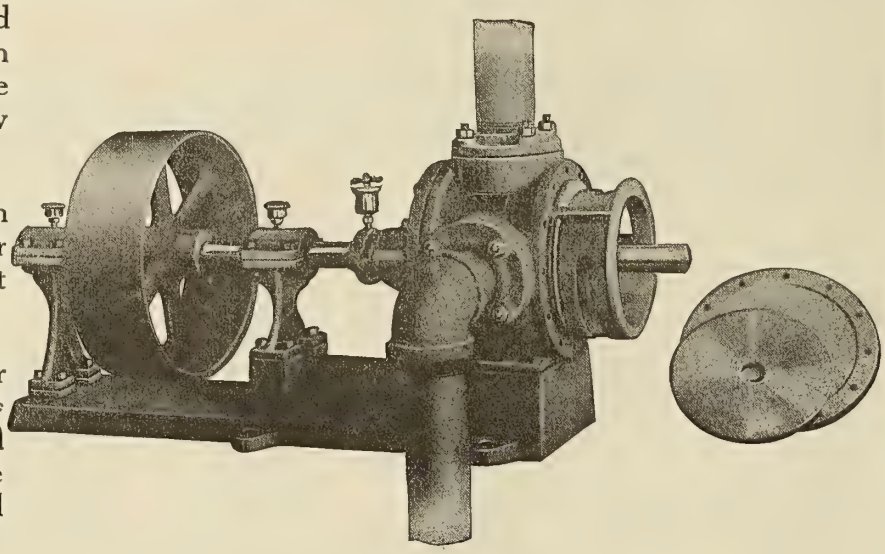
ONE of the first things you notice about a Blackmer Marine Pump is that only a fraction of the space usually required is necessary when one is used—and space on a boat is precious.

Although installed for bilge work Blackmer Marine Pumps can be used in emergencies for fire protection as well as for washing down decks.

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Their sturdy construction guarantees long life—their simple operation permanent favor.

The adoption of Blackmer Pumps for Marine Service is universal. You too should use this equipment. They are the eventual choice of critical buyers.



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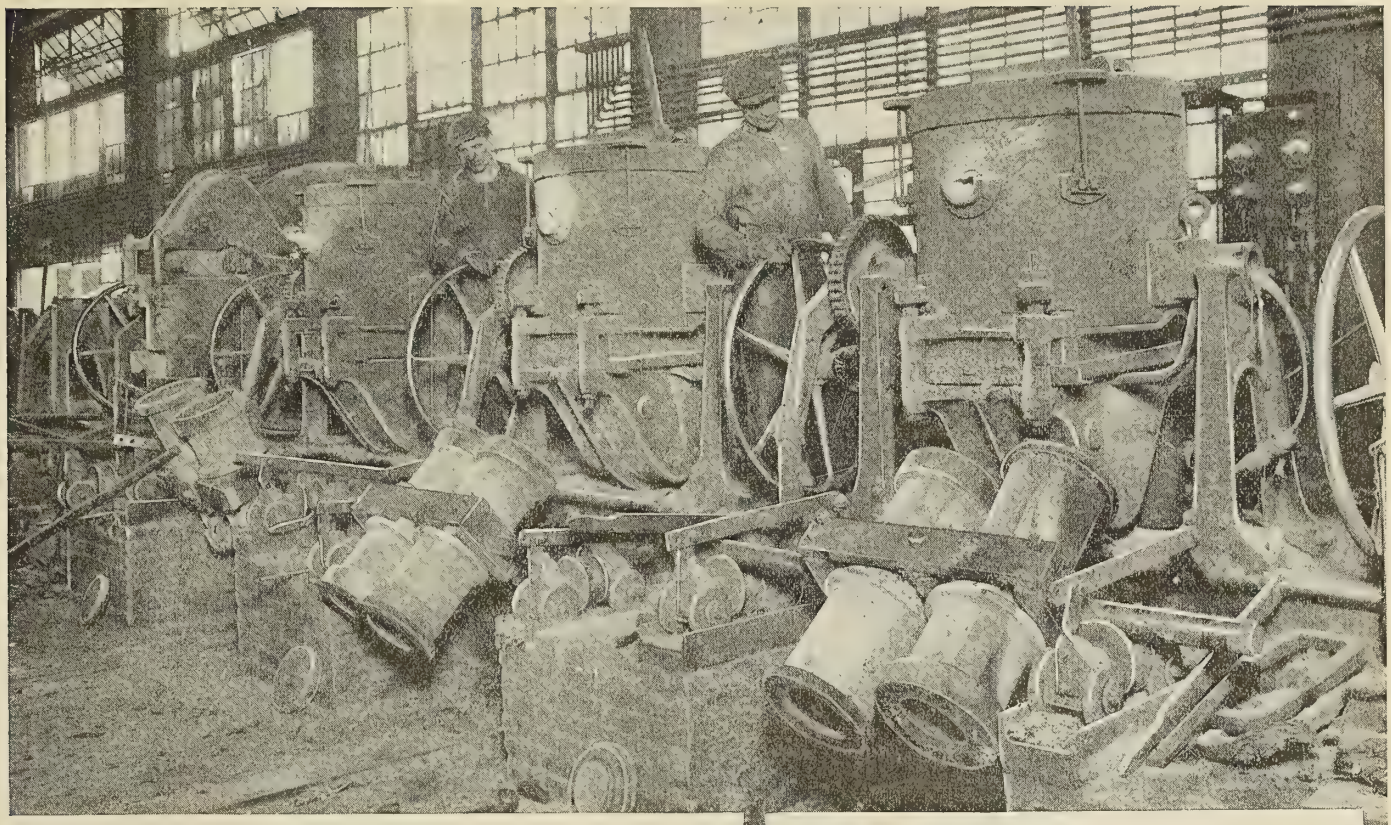
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The Best Condenser Tubes and Ferrules Are Made in the Electric Furnace

"Electrical Aids to Greater Production" states: "It has been found in most cases that a more uniform quality of metal can be produced in the electric furnace than in fuel-fired furnaces and that it is easier to produce an alloy of closely specified composition. . These advantages can be accepted as inherent in electric furnace operation resulting from the greatly reduced loss of volatile metals and from the elimination of contaminating combustion gases."

For the past three years the Bridgeport Brass Company has been changing from the crucible process to the Electric Furnace.

Today the output is exclusively

BRIDGEPORT ELECTRIC FURNACE BRASS

(All Bridgeport Brass is made in Electric Furnaces)

Condenser Tubes, Sheets, Rods and Stampings

Bridgeport Brass Company

Bridgeport Connecticut 2187



More Than a Catalog

This Catalog of G & K Standardized Series Leather Belting and Leather Products is practically a handbook of leather tannage and manufacture.

It is carefully compiled and indexed for easy reference to the products you want.

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THE GRATON & KNIGHT MFG. CO.,

Oak Leather Tanners and Belt Makers,

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"The Right Packing in the Right Place"

The United States Rubber Company manufactures a specific packing for every known mechanical condition.

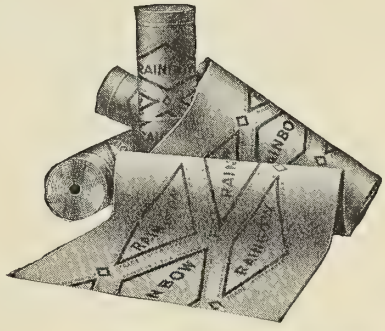
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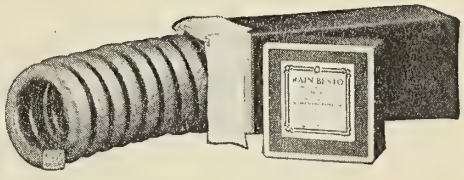
Our engineers are at your service to aid you in determining the most suitable type or combination to meet each of your needs.

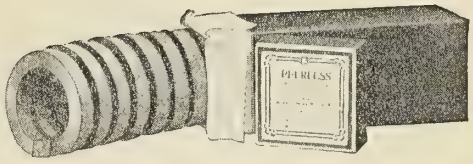
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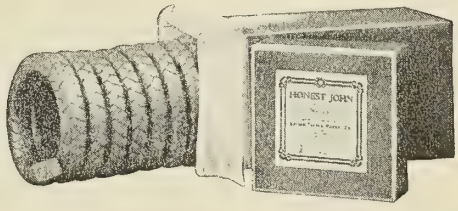
Rainbow Sheet	Peerless Braided Flax
Rain-Besto H.P. Spiral	Peerless Special Canvas Pump
Peerless Piston	Vanda Compressed Sheet
Success Diagonal	Wizard Valve Stem
Honest John Hydraulic	U. S. Rubber Pump Valves

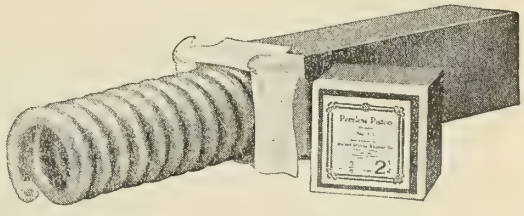
United States Rubber Company

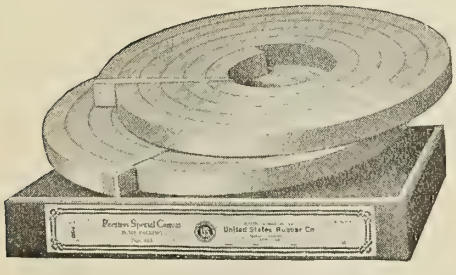


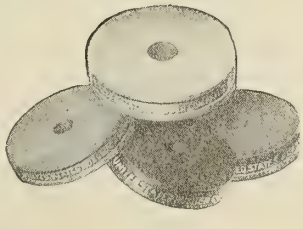














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MIDWEST MARINE POWER

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—*Low Cost of Propulsion*—is guaranteed because power is obtained from inexpensive crude or fuel oils.

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—*Inspection Made Easy*—by the open crank case.

—*Adjustments Simplified*—pistons and piston-rings remove without dismounting cylinder heads or connecting rods.

Write for detailed information concerning this or other Midwest products—or see our representatives in your nearest large city.

Oil Engine Products

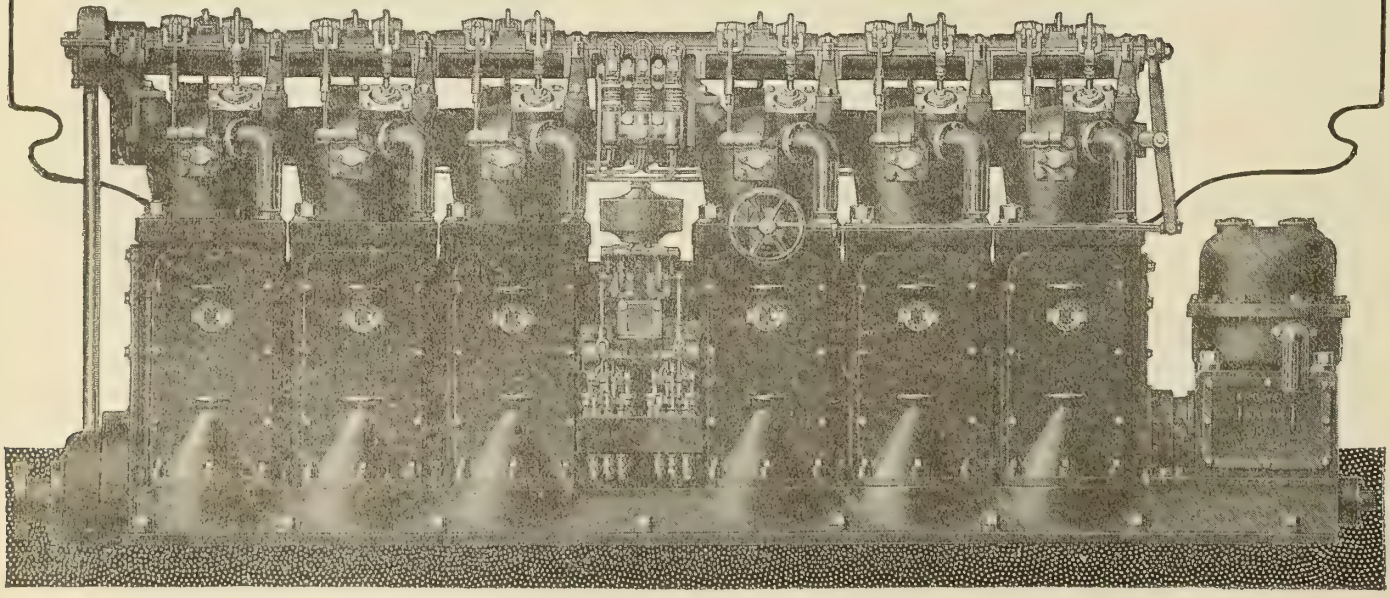
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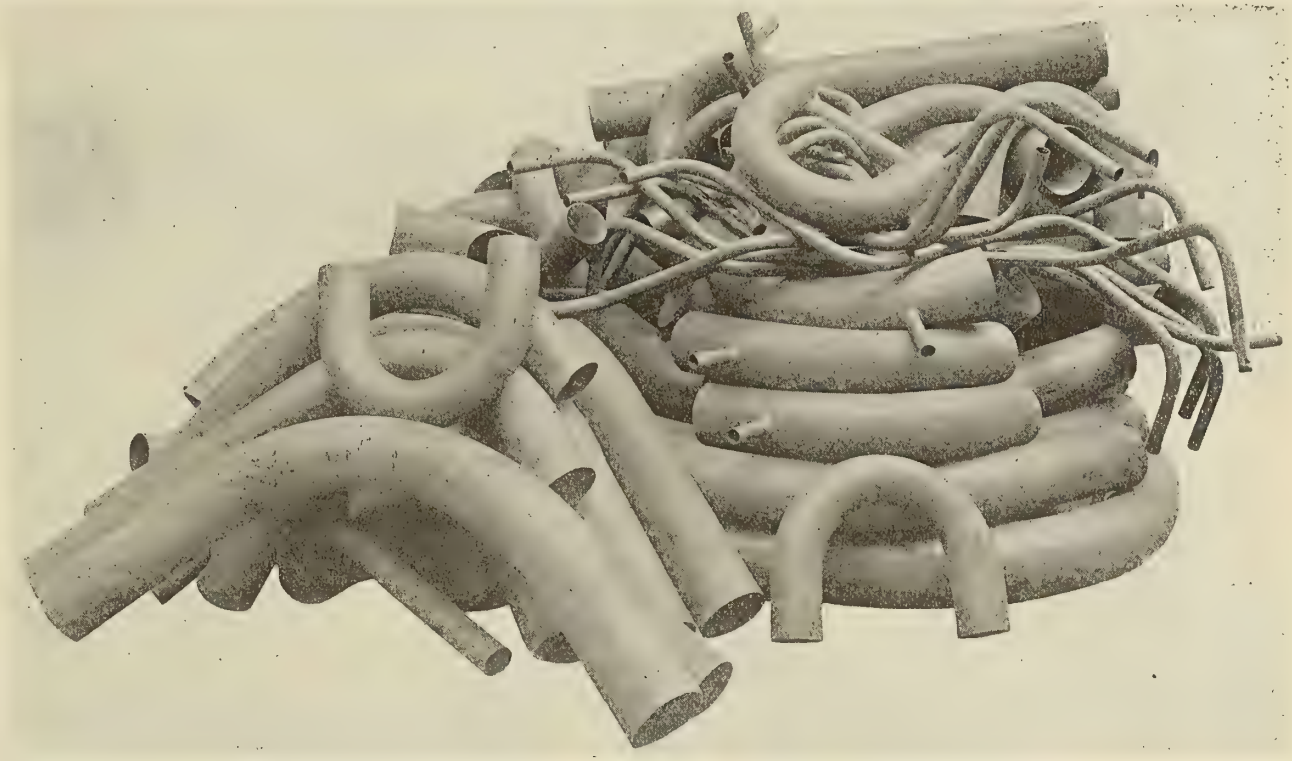
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supplied to meet the war demands of

THE EMERGENCY FLEET CORPORATION



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The Badger Service will give you the benefit of over seventy-five years' experience in solving the problems of your Copper work.

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After fifteen years of engineering and manufacturing experience—years of pioneer work in the development of scientific lubrication—the products of the Richardson-Phenix Company have come to be recognized as standard and Richardson-Phenix lubrication engineers as the final authority on all problems pertaining to scientific lubrication.

In order that all products, and all literature and advertising of this company may be instantly identified, the trade-mark reproduced has been adopted.

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Automatic Equipment for the scientific application, reclamation and handling of Lubricating Oils.
Automatic Oiling and Filtering Systems.
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Oil Filters and Reclaimers.
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Bulletin S-25 fully describes R-P Automatic Oil Circulating and Filtering Systems. It contains some mighty interesting engine data and is well worth your investigation. Write for your copy It is waiting.

R

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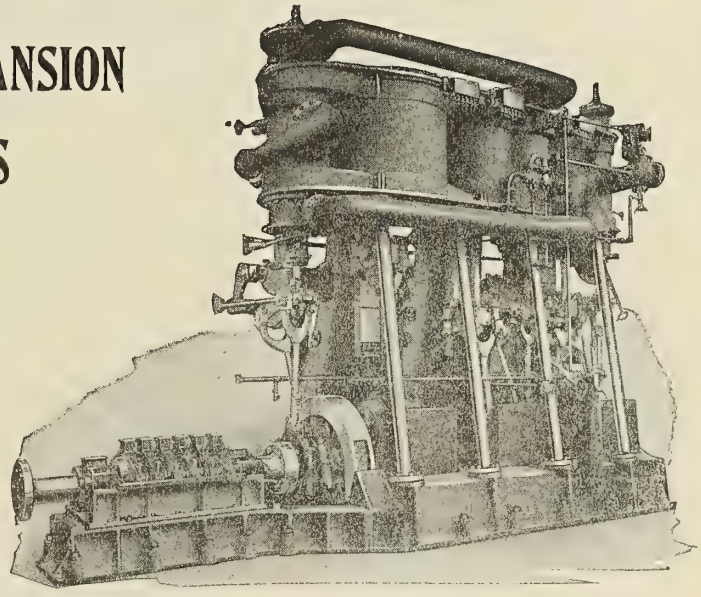
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SCIENTIFIC LUBRICATION

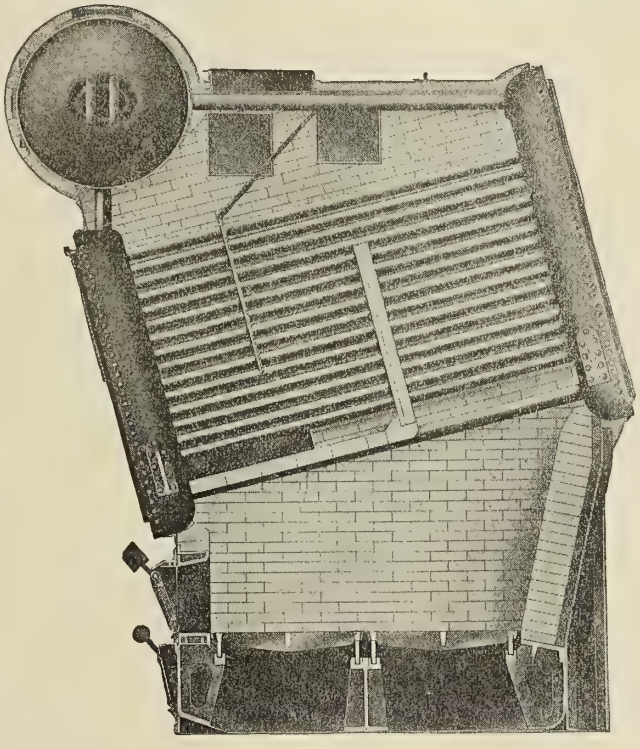
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COMPOUND AND TRIPLE EXPANSION MARINE PROPELLING ENGINES BUILT IN STANDARD SIZES FOR TUG BOATS AND SHIPS

Perfectly Balanced in design and operation



DURABLE **DEPENDABLE** **ECONOMICAL**



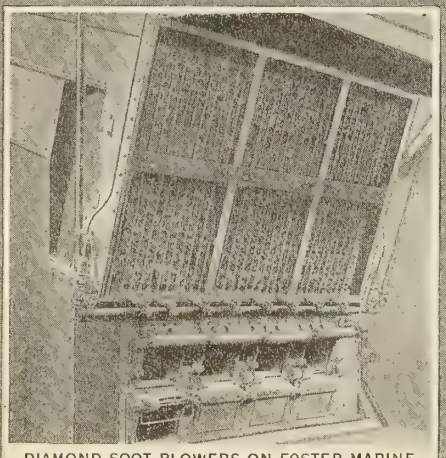
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Straight tube type
Generous combustion chamber
No rivets in contact with fire

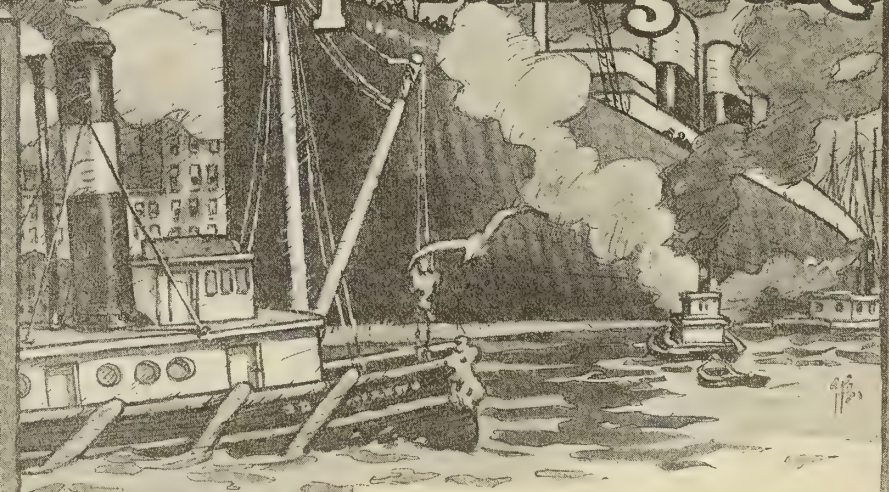
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Diamond SOOT BLOWERS Reduce Vessel Operating costs



DIAMOND SOOT BLOWERS ON FOSTER MARINE WATER TUBE BOILERS



There Are Diamond Soot Blowers For Every Type of Steamship!

and every steamship needs them

Why?
Because:

1. Their function is to remove ALL soot and fine ash deposits from the fire surfaces of the boiler. You do not expect efficiency from a gasoline or oil engine the cylinders of which are choked with carbon—you do not expect speed from a barnacle-incrusted hull—you do not look for clear-headed thinking and action from a man whose nasal passages are filled with a heavy cold. How, then, can you expect efficiency and economy from a dirty boiler?
2. If you grant that soot removal is necessary, you will undoubtedly admit that complete cleaning is the only cleaning worth while. There are just two systems which you can employ—the steam hose with hand lance, which is 50% effective, and it a dirty, disagreeable and tedious as well as dangerous job—and the rapid, thorough, mechanical soot blower, which is 95% effective.
3. As compared to hand lance cleaning, Diamond Soot Blowers will effect the following economies:
   (a) FUEL—a saving of 4 to 8 per cent.
   (b) BOILER EFFICIENCY—an increase of 4 per cent or more.
4. Increasing boiler efficiency of a steamship as Diamond Soot Blowers do, produces the following results:
   (a) SPEED—a material increase.
   (b) STEAMING RADIUS—a notable increase.

In marine use for over eighteen years, Diamond Soot Blowers have demonstrated their worth on boilers of every description, and steamships of every type. If your vessel, whether tug, dredge, ferry boat, small coasting steamer, trawler, lake passenger, ore freighter, ocean tramp, giant liner or battleship, is not equipped with Diamond Soot Blowers, write for full information, requesting your copy of Bulletin 134, "How Some Ship Owners Have Increased Their Profits."

DIAMOND POWER SPECIALTY COMPANY
Detroit, Michigan

Diamond

SOOT BLOWERS - SAVE 4 to 8% FUEL

Piping used on board ship should be free from welding-scale

—to minimize frictional resistance in feed, service and suction lines;

—to have an evenly distributed and closely adhering galvanizing coating;

—to reduce any tendency to corrosion caused by galvanic action which obtains when scale is present;

—to prevent trouble caused by dropping or settling scale in valves and other apparatus;

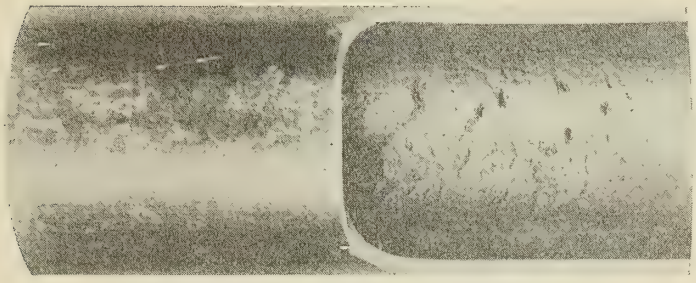
—to secure neatly finished surfaces with enamels, paints, etc., on exposed lines.

THESE ADVANTAGES ARE OBTAINED BY USING

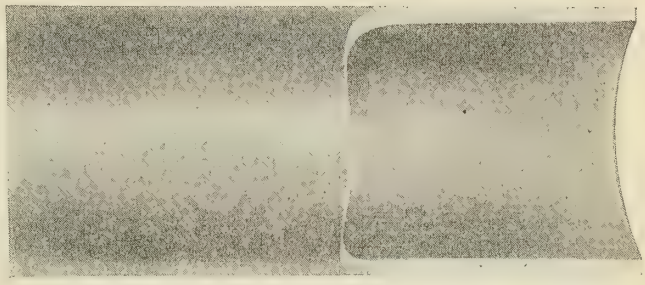
"NATIONAL"

Welding-SCALE FREE Pipe

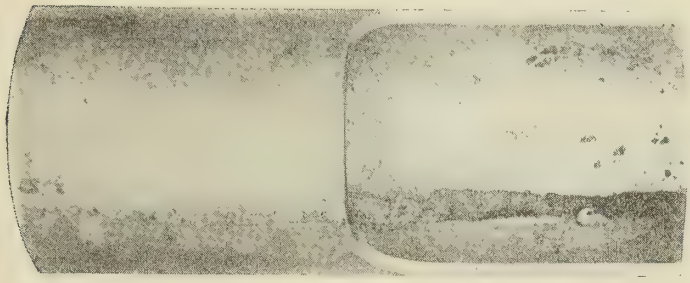
(Butt-weld pipe with the heavy mill-scale or welding-scale removed)



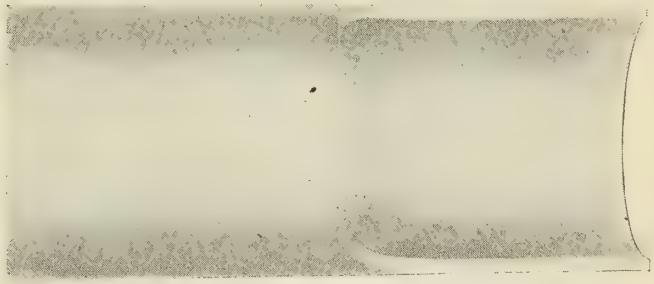
Ordinary black butt-weld pipe, showing characteristic coating of welding-scale.



"NATIONAL" Welding-SCALE FREE Pipe, showing clean, smooth surfaces of this modern product.



Showing condition of galvanizing on ordinary, scale-covered butt-weld pipe.



Note even and close adherence of galvanizing on this "NATIONAL" Welding-SCALE FREE Pipe.

"NATIONAL" Bulletin No. 7 — MANUFACTURE AND ADVANTAGES OF "NATIONAL" Welding-SCALE FREE Pipe—contains a detailed description of the scale-removing process and its advantages. A copy will be sent free upon request.



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General Sales Offices: Frick Building

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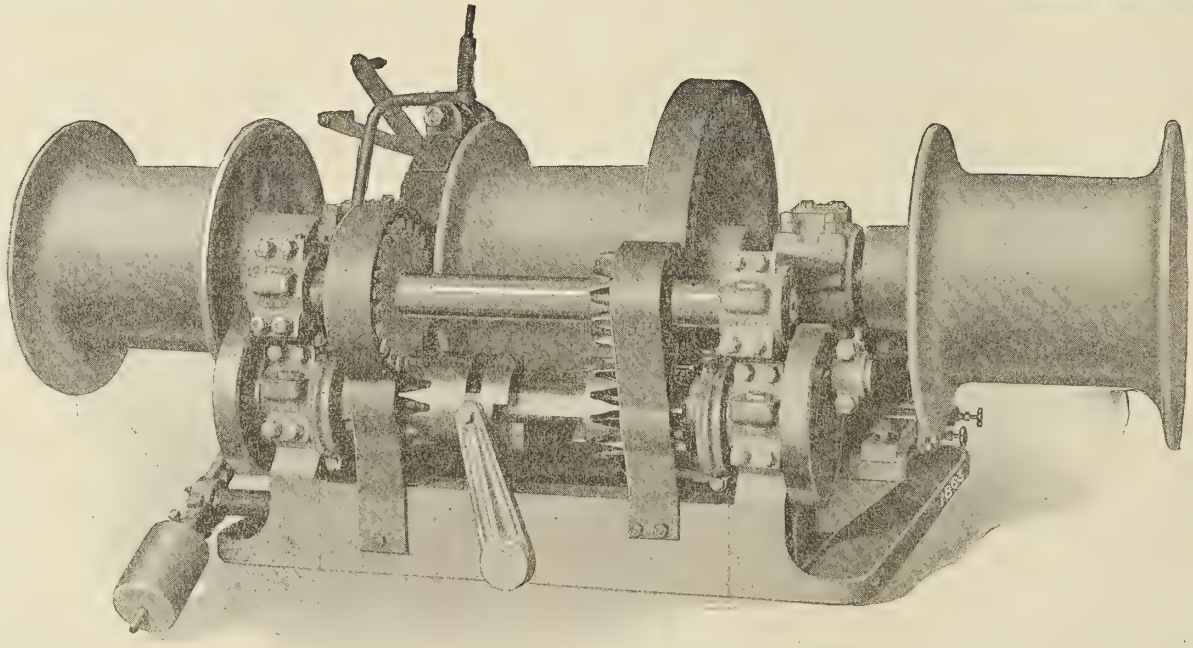
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STANDARD WINCHES

Single Geared
Catalog No. 1917

Compound Geared
Catalog No. 1917-C



Lidgerwood Compound Geared Cargo Winch No. 1917-C

Drum holds 800 feet of ¾″ rope and delivers a line pull of 10,000 lbs. with drum full of rope.

Built for handling a 30 Ton Boom with eight part purchase.

Light Loads at High Speed, Heavy Loads at Slow Speed.

Simple in control. One lever hoists, holds and lowers. All gears steel.

All parts interchangeable.

Lidgerwood Compound Geared Cargo Winch No. 1917-C is exactly interchangeable on the same bedplate and pipe flanges with Lidgerwood Standard No. 1917 Winch over 6,000 of which have been constructed and sold.

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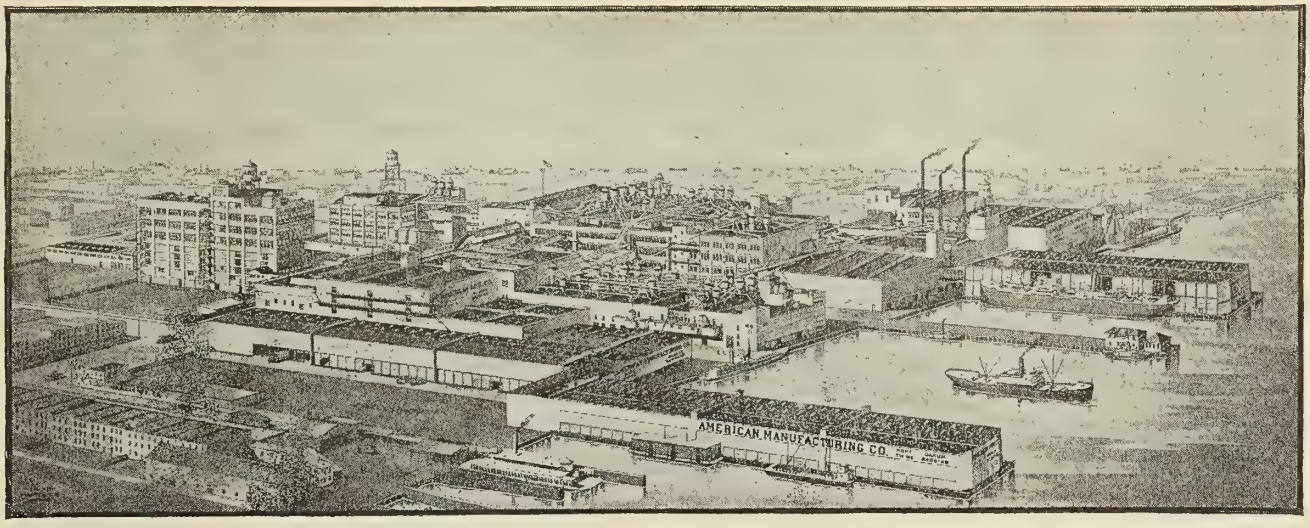
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40% Increased Production

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SIMILAR RESULTS ARE POSSIBLE IN YOUR PLANT!

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But the bending is no longer done by the ordinary hand procedure of squeezing the bar against the form with a crescent-shaped "crowder," handled by a **HALF DOZEN MEN.**

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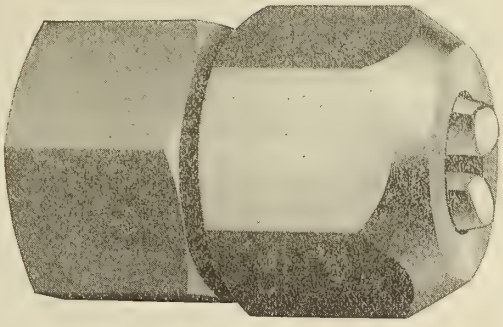
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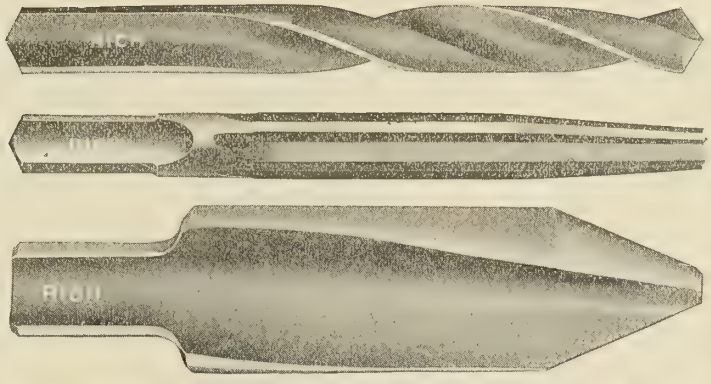
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Eliminate Lost Time and Breakage of Costly Tools in Shipbuilding Work

BY USING RICH

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The RICH COMBINATION consisting of Chuck (with taper or screw-on type) and Groove shank Tools meets those conditions found in shipyards where unskilled labor is the big factor to be reckoned with. The breakage of expensive drills, reamers and countersinks is an endless source of waste even under favorable conditions of operation. RICH Groove shank tools come in shorter lengths than taper shank tools and are thus better adapted for use with portable air or electric tools. They are held in the chuck with a positive grip and cannot slip out and fall through a deck or overboard. The RICH Combination is designed to withstand the rough usage of shipbuilding work, and in its rugged construction and economical operation practically solves the Small Tool problem of the shipyard.

Made to fit all types of air or electric tools.

Enables the operator to get close to the work.

With a turn of the chuck nut, tool can be changed quickly from drill to reamer or countersink.



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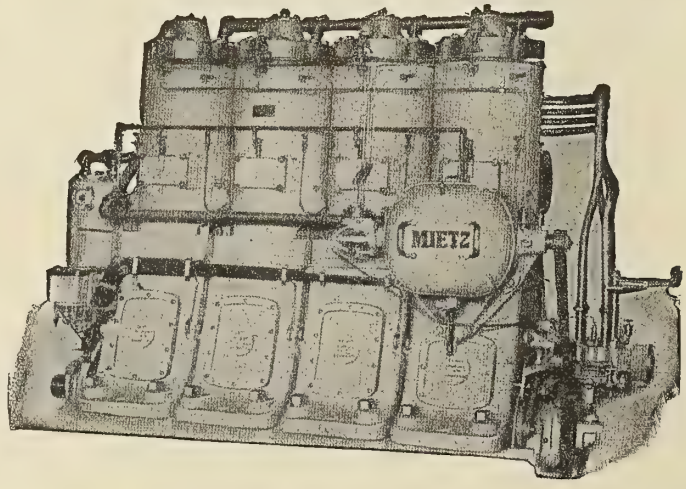
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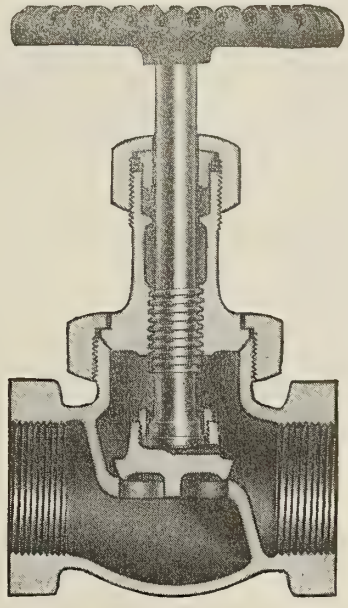
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No. 82E

These valves may be repacked when wide open and under pressure. They are made with packing gland, and are fitted with strong malleable iron non-heat hand wheel. The Union Bonnet adds strength and durability. They have liberal stem diameters and threads. Recommended for steam working pressures up to 250 pounds.

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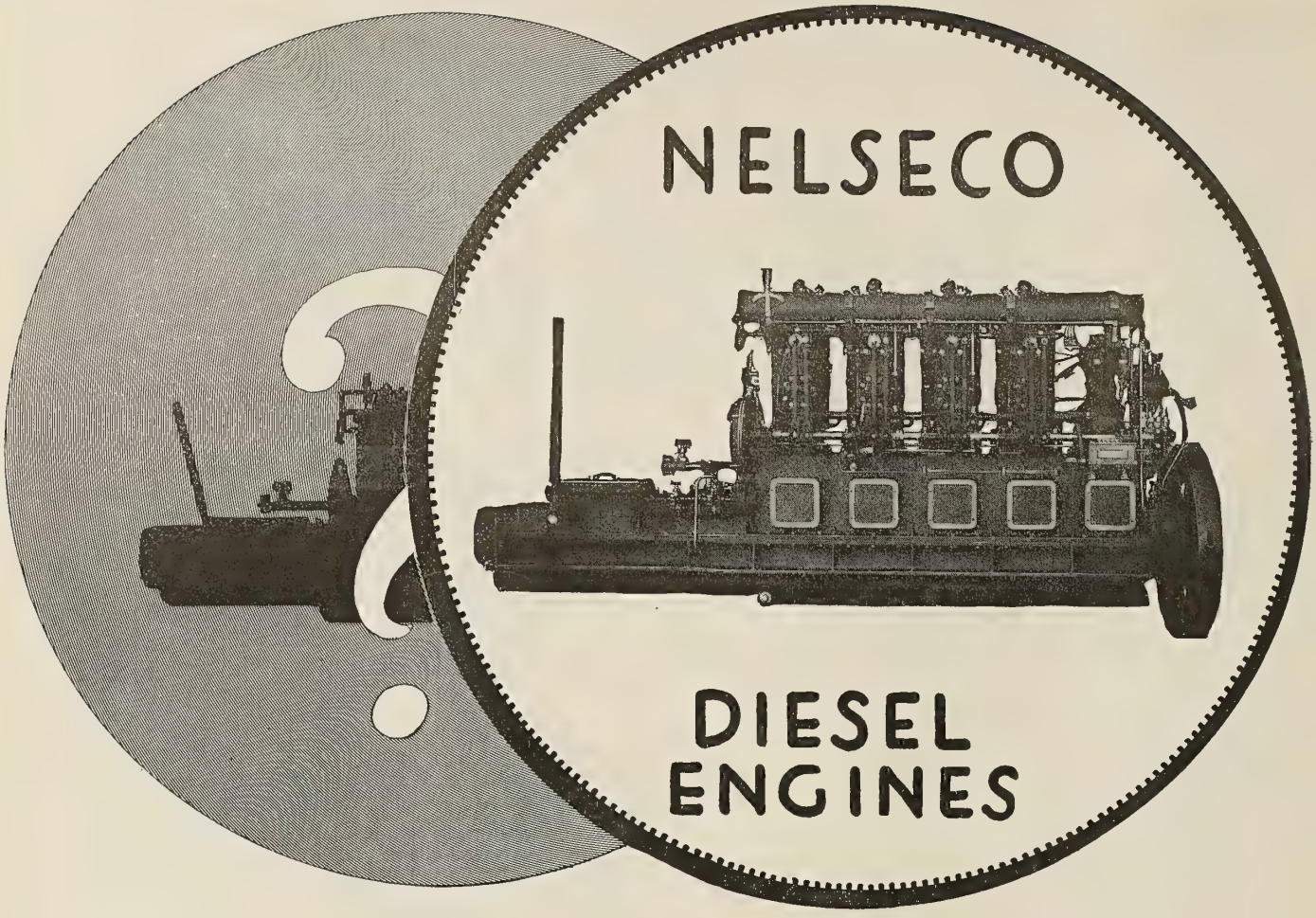
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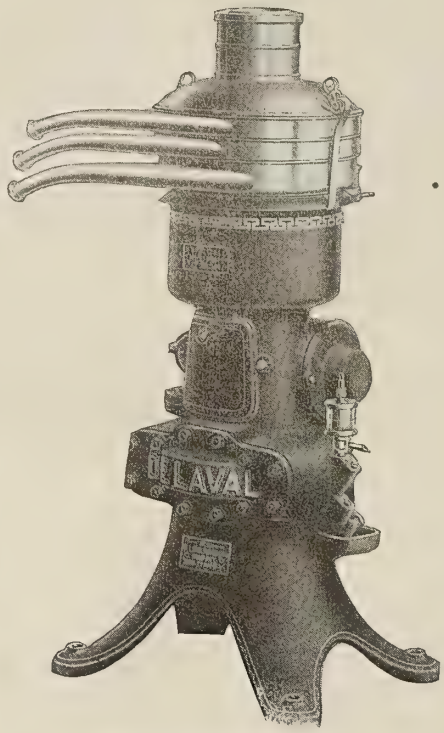
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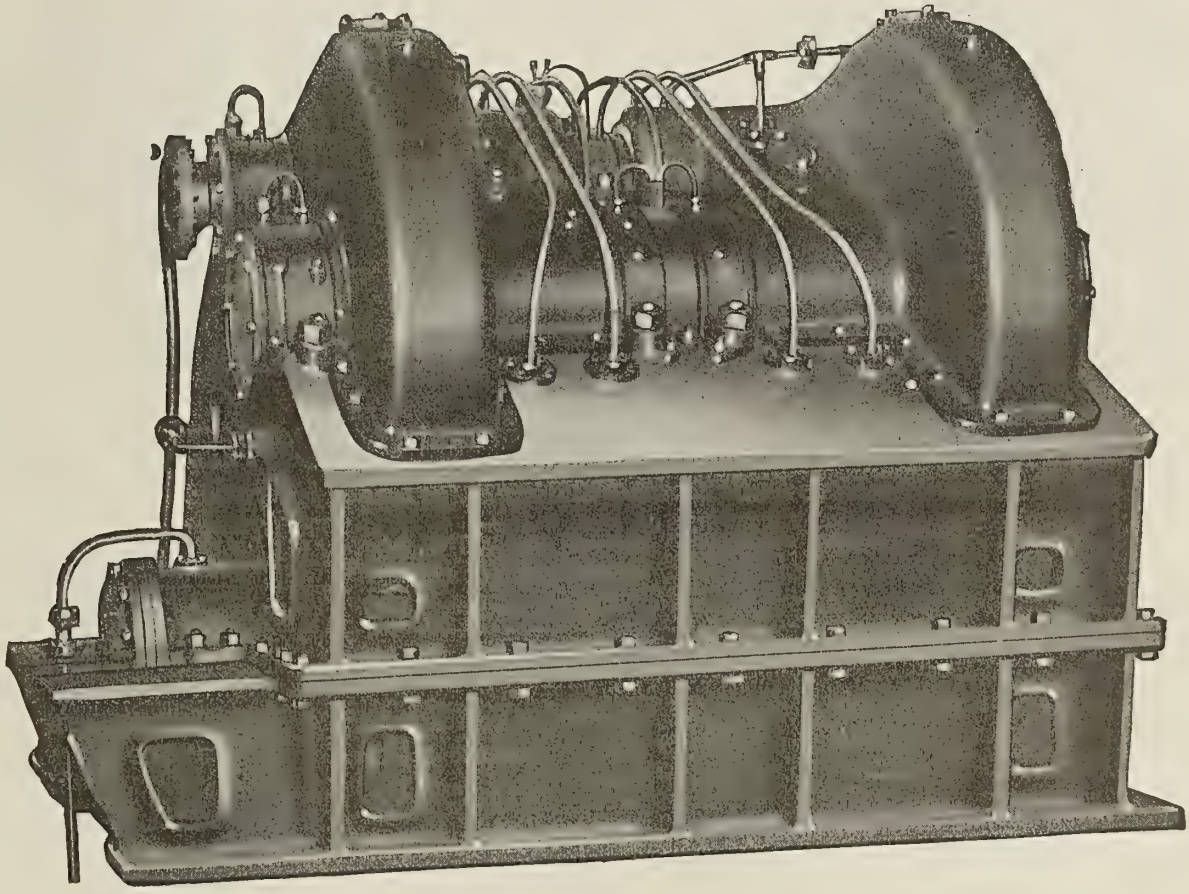
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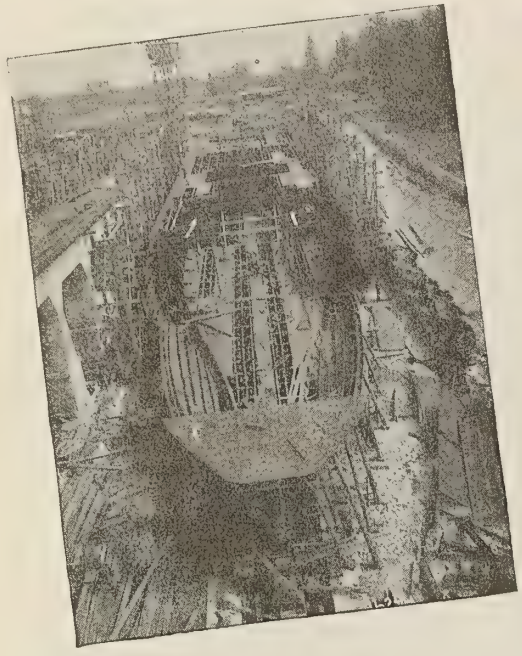
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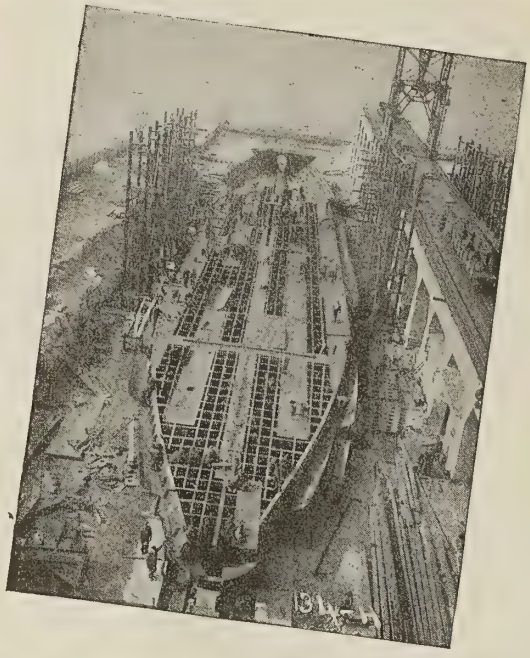
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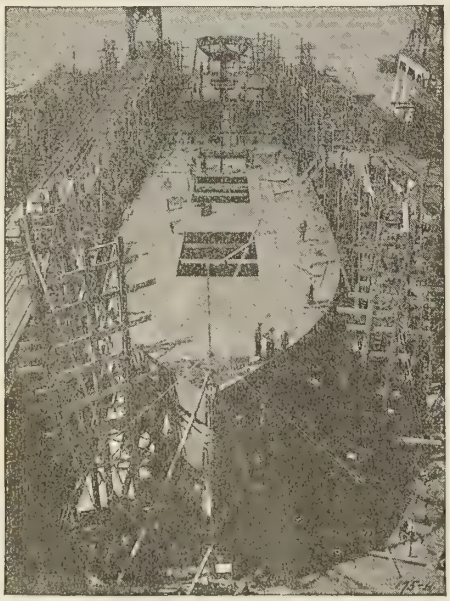
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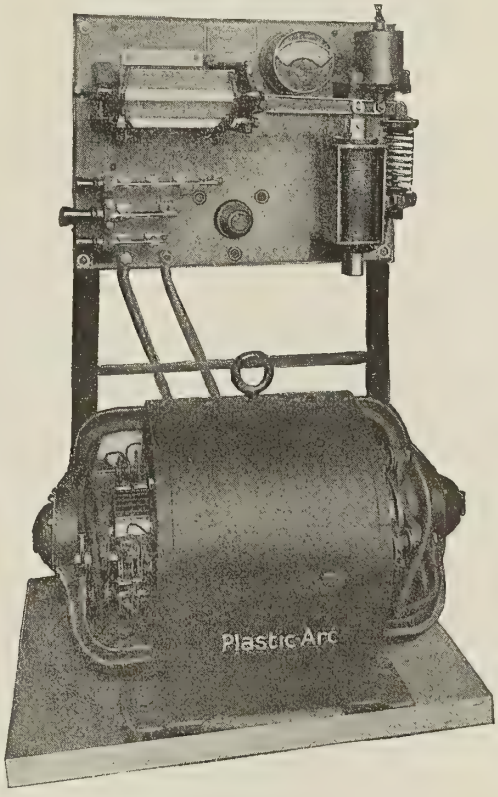
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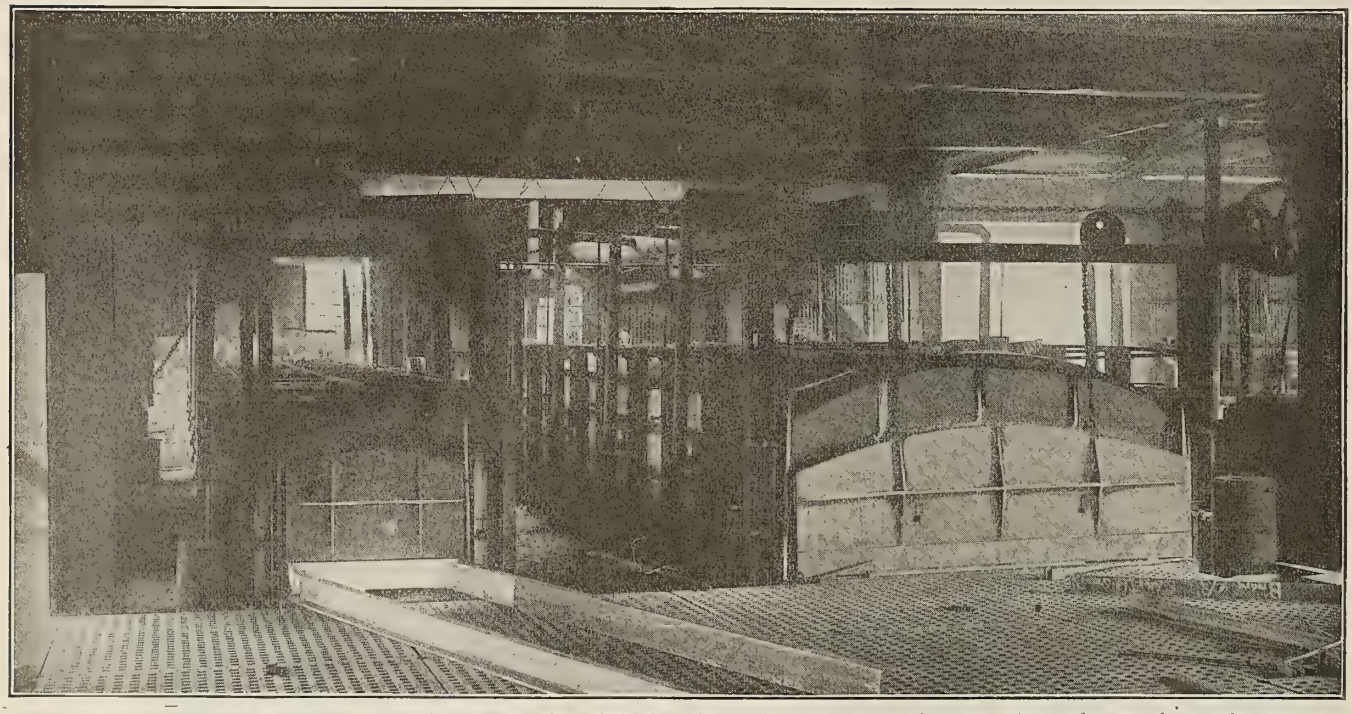
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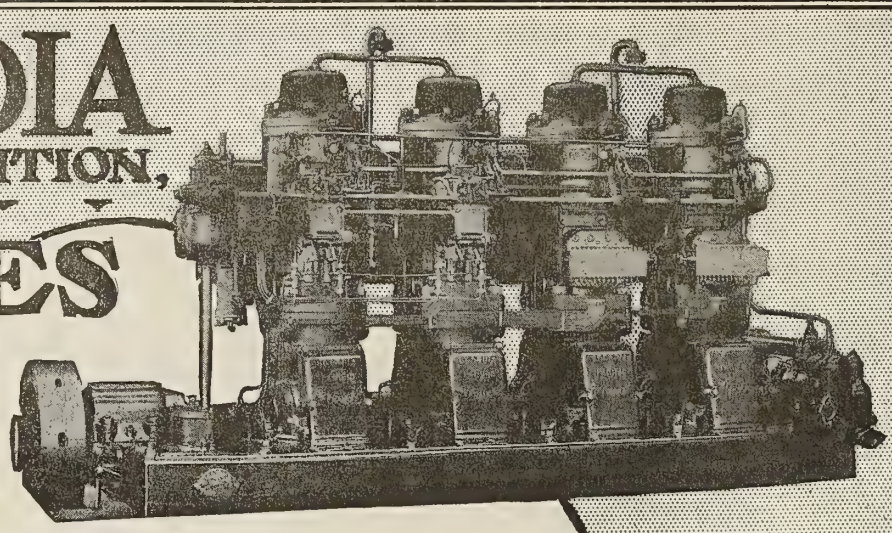
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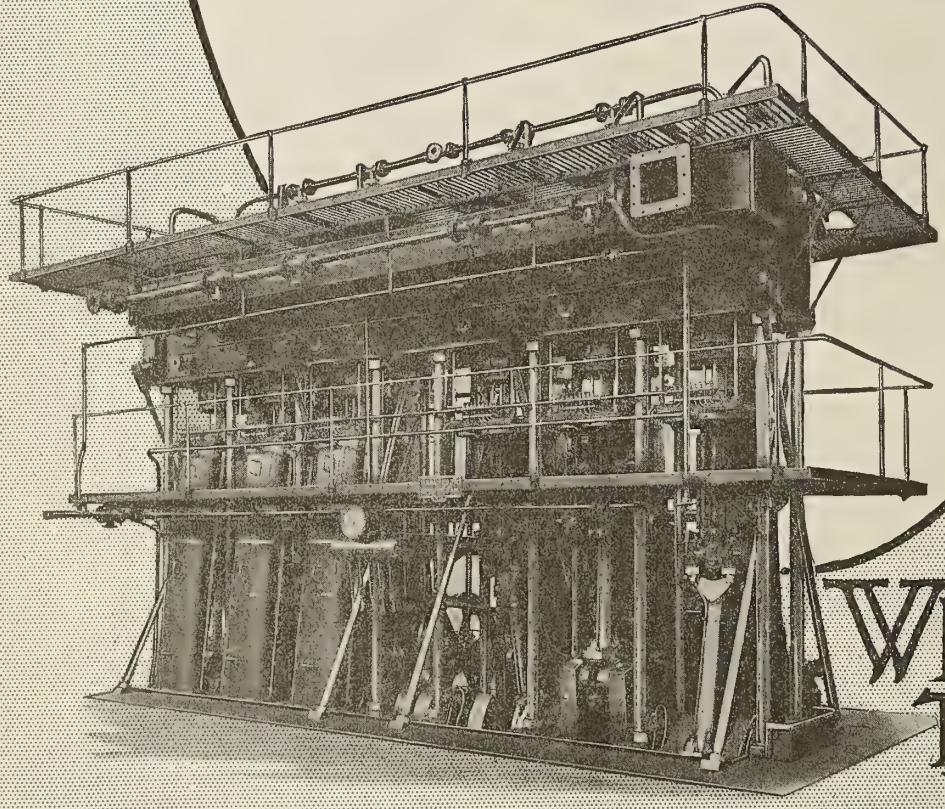
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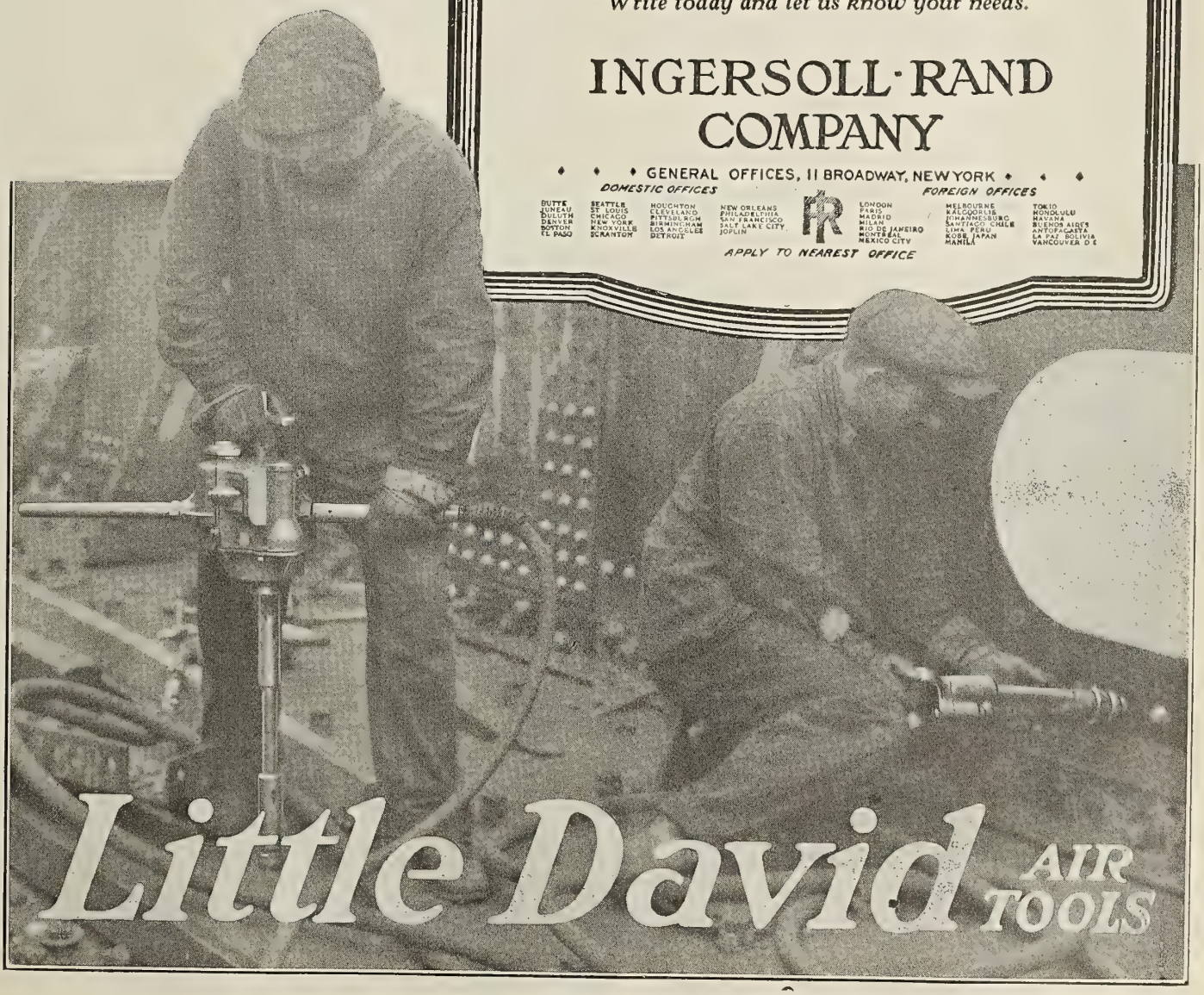
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Little David AIR TOOLS

The Bradley Cushioned Helve Hammer

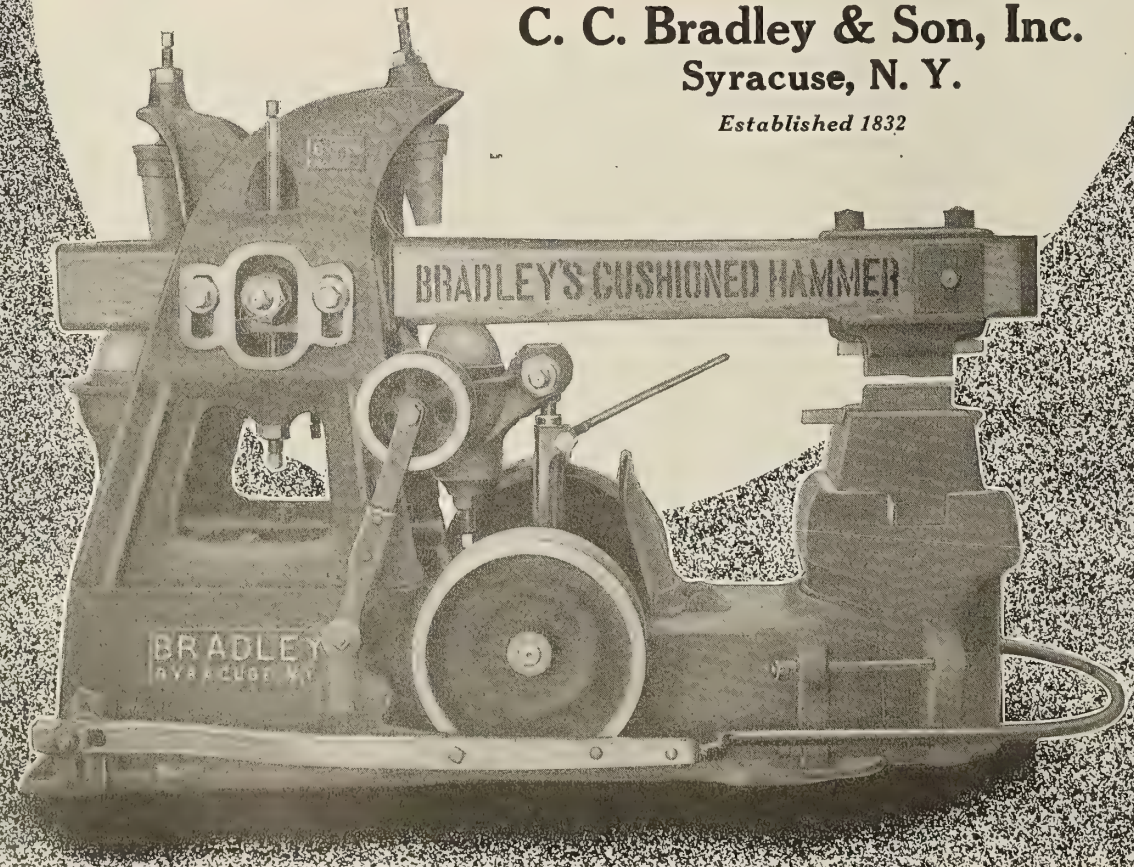
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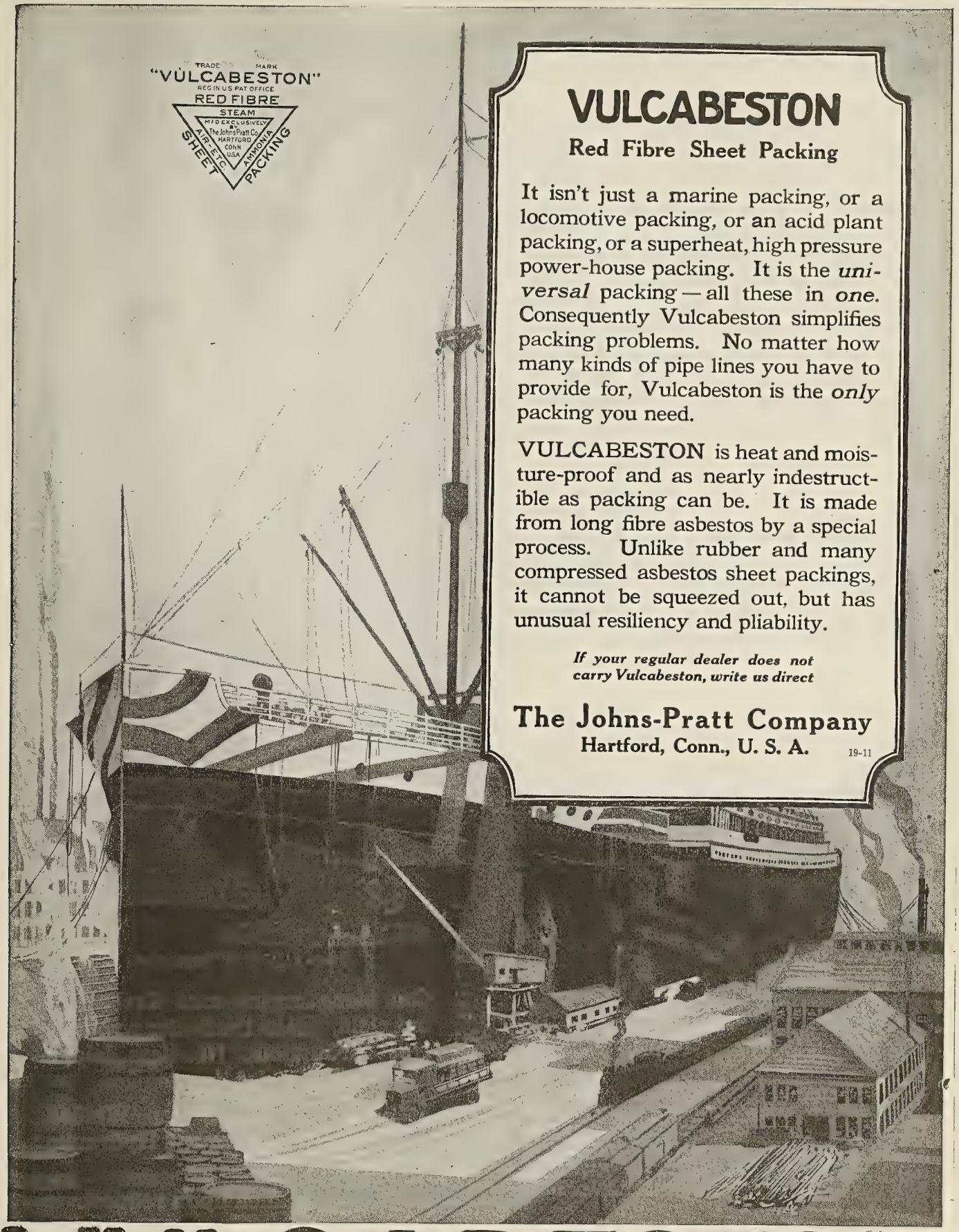
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Both the speed and force of the blow are thus completely under control of the operator.

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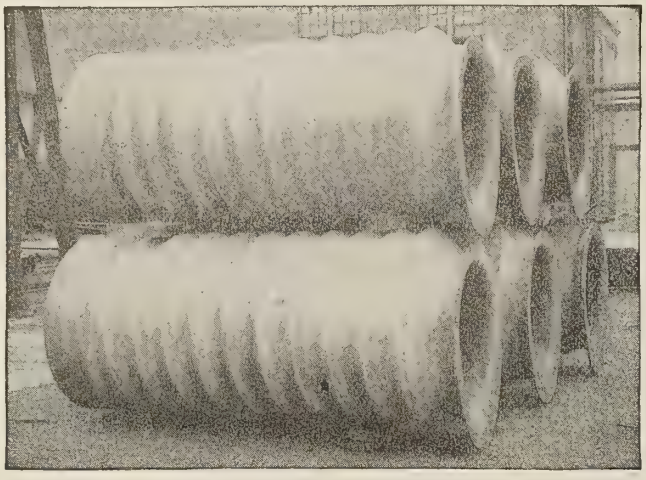
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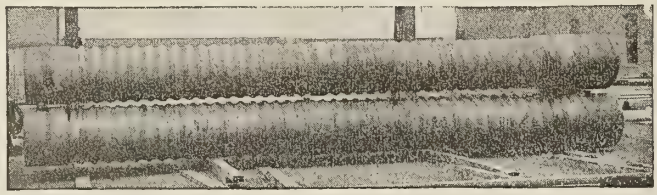
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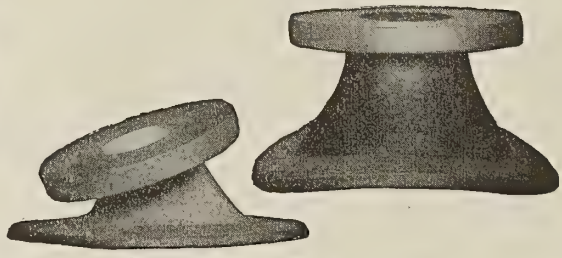
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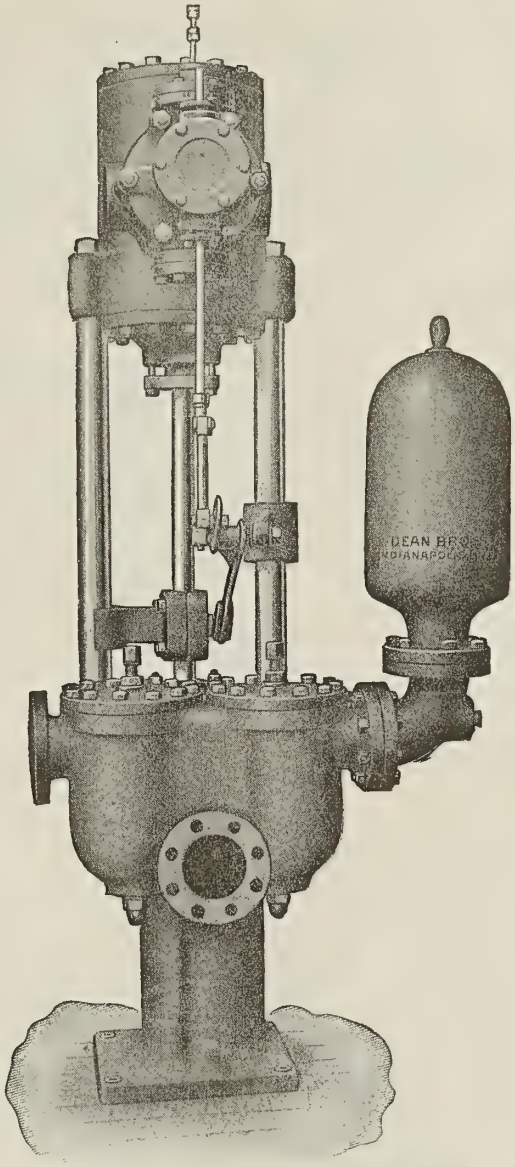
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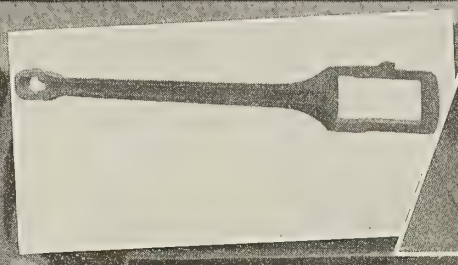
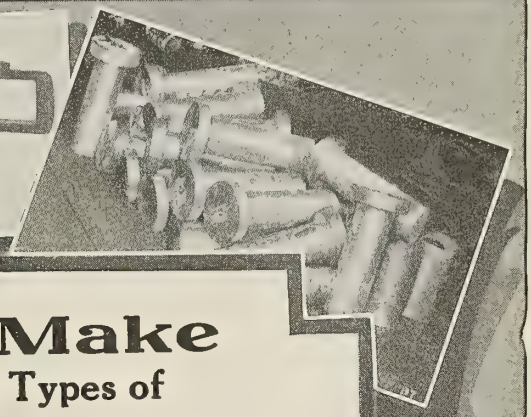


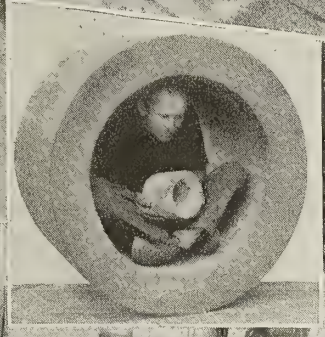
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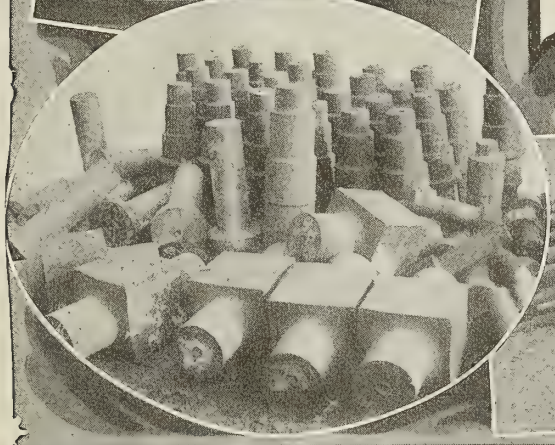
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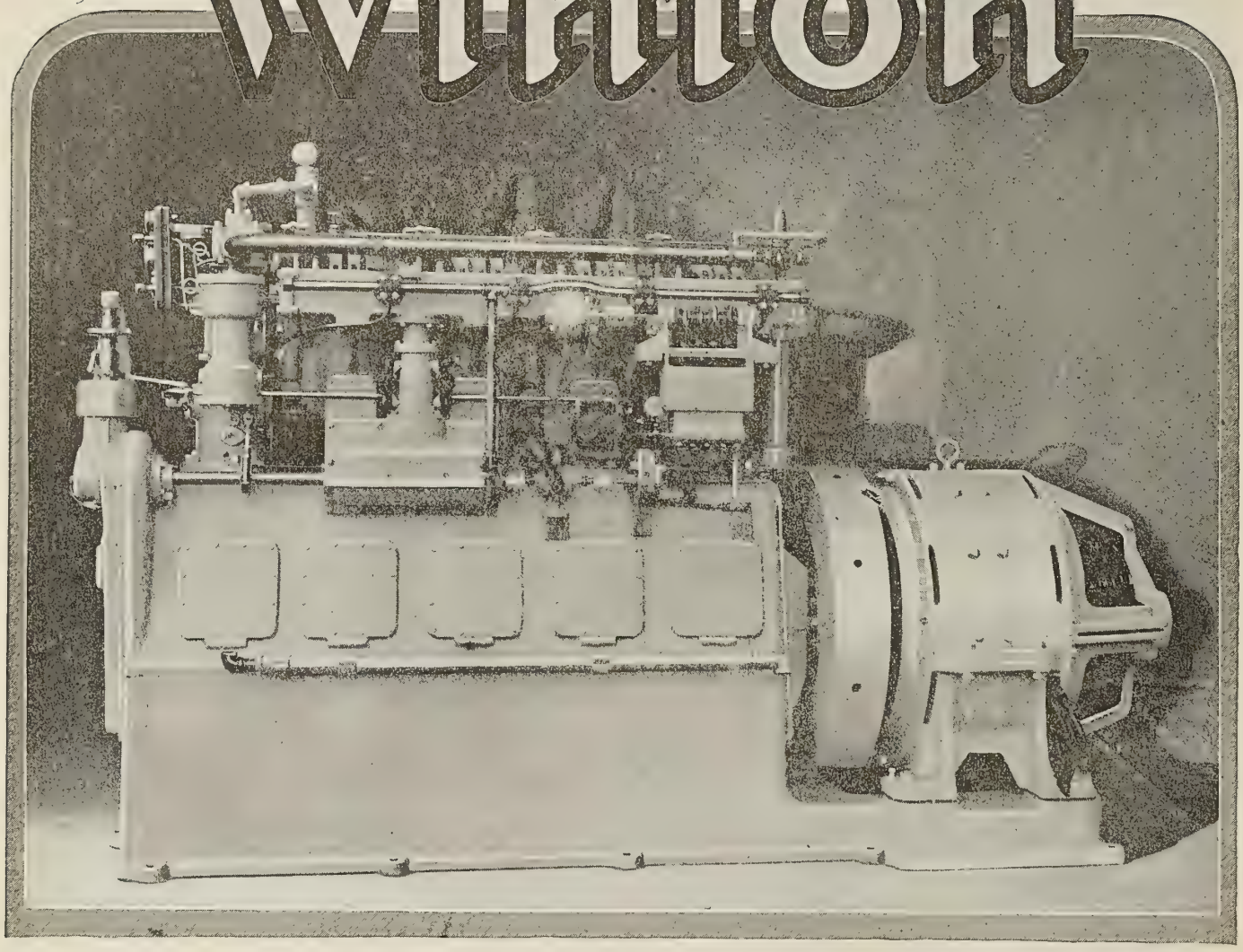
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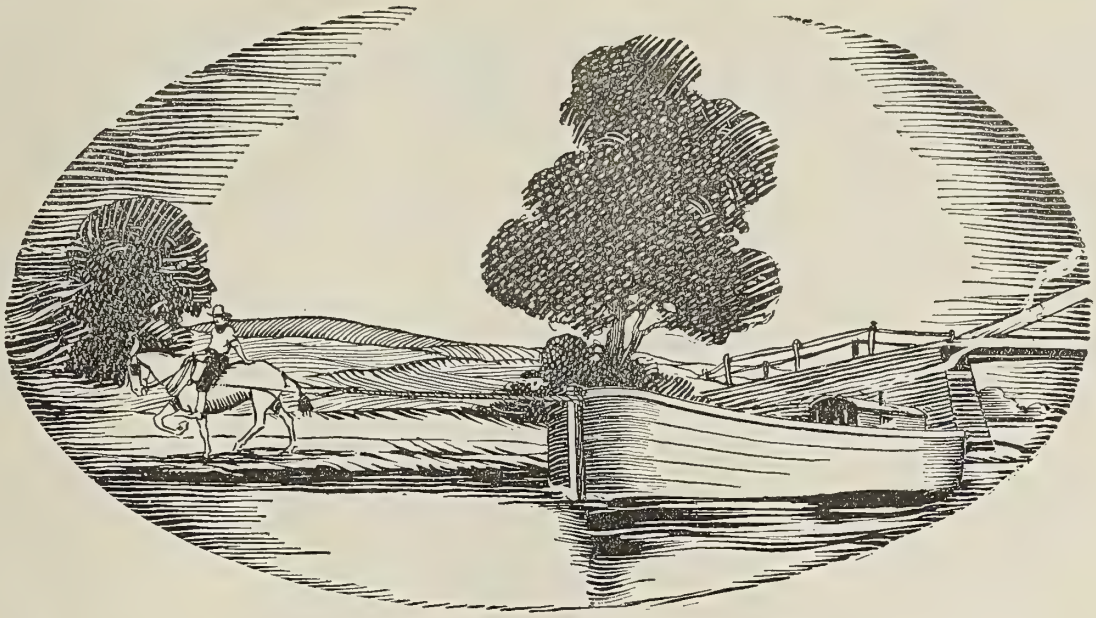
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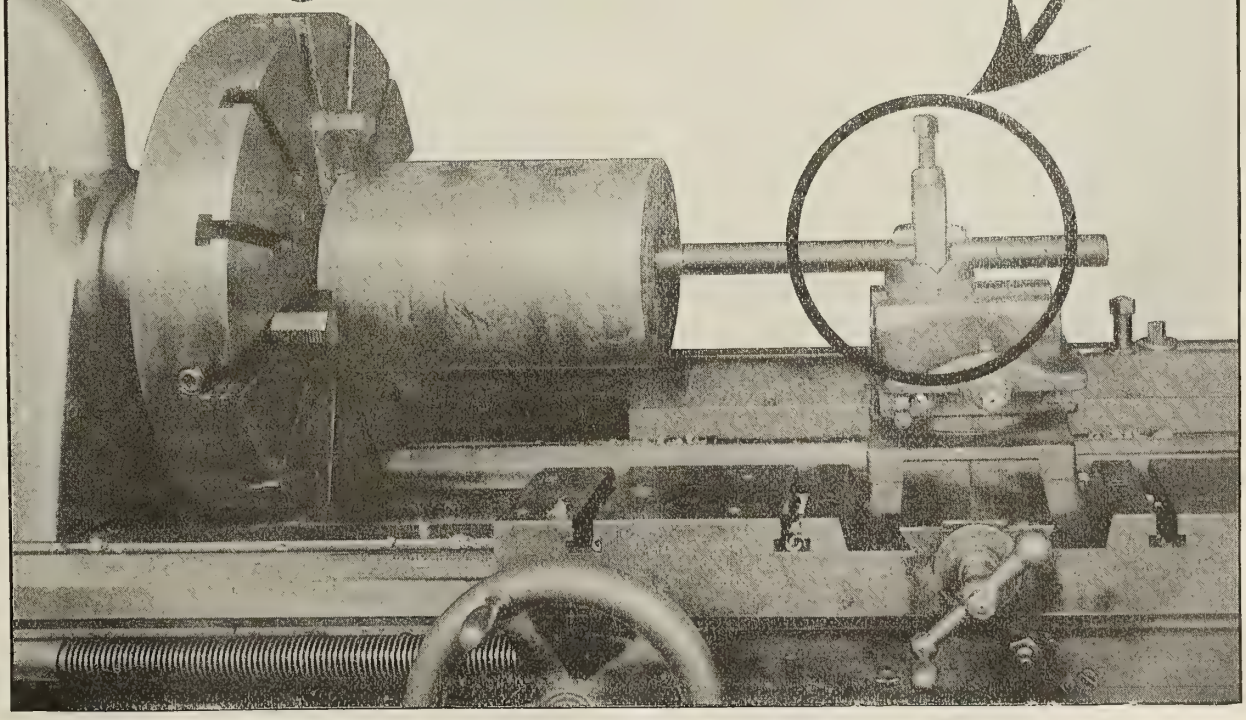
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Standardized Interchangeable



Water Tight Reflector Fixtures

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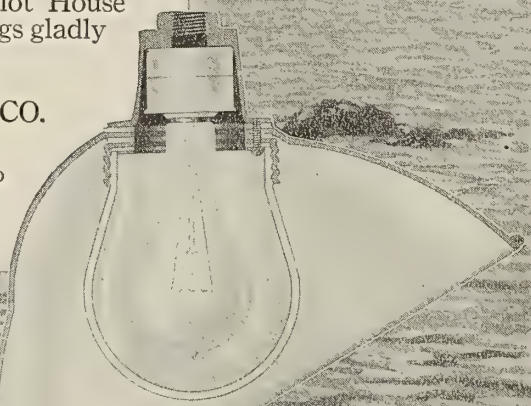
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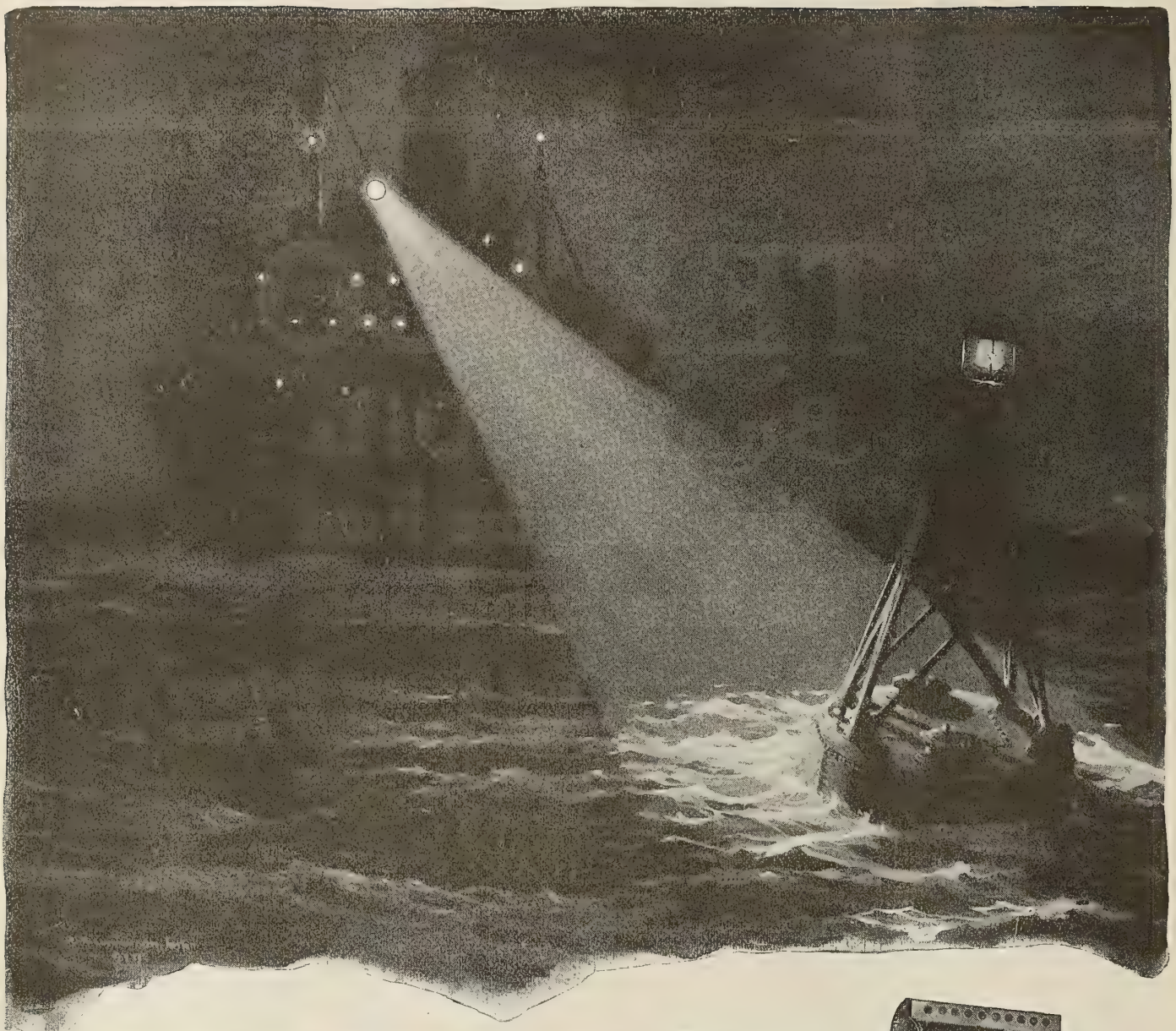
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Difficult Channels Are Easily Picked Out At Night With a Sperry Searchlight

A DARK night and a haze that hides the distant lights spell danger for the navigator.

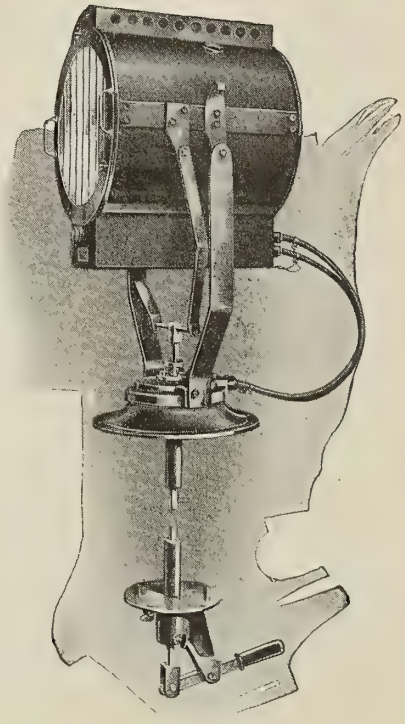
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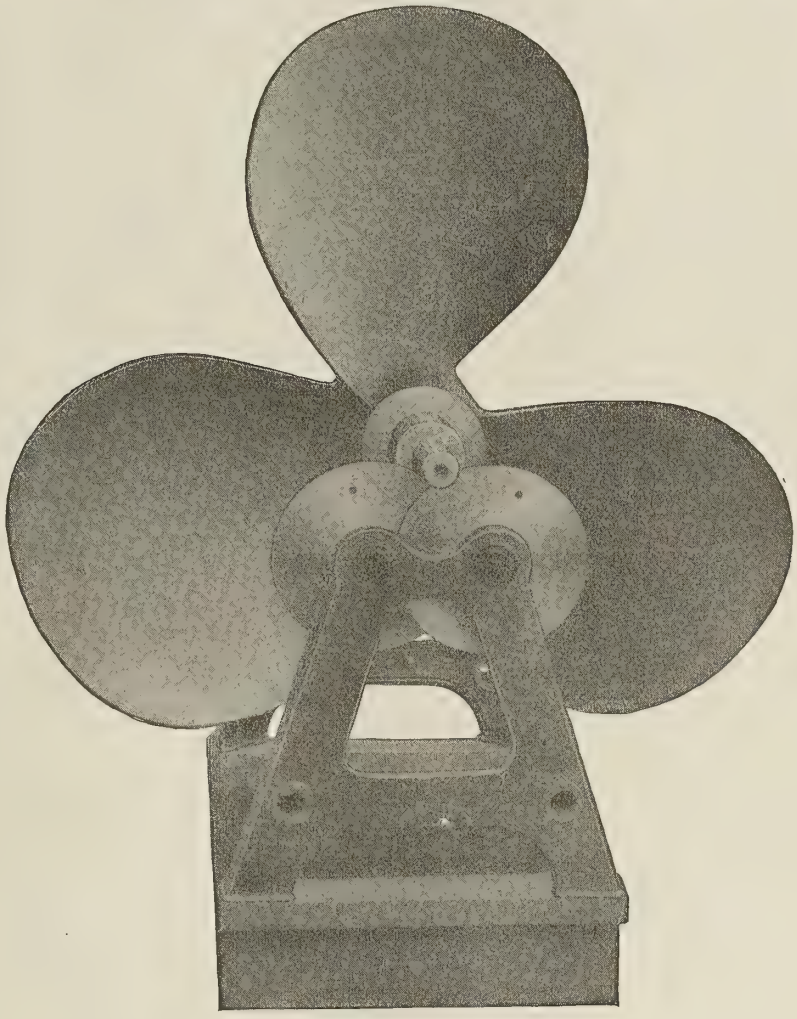
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Thacher Patented Process Wheels Balance Perfectly

This wheel has not been touched except for boring
and the above test proves it to be in perfect balance

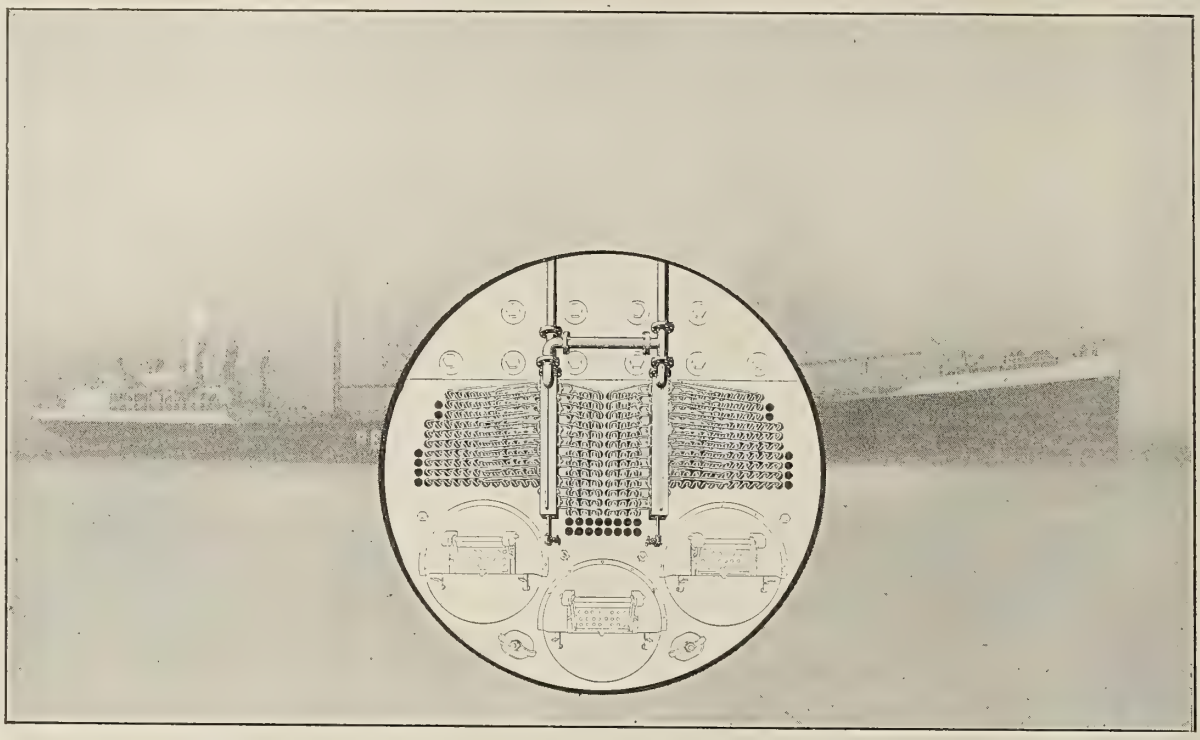
DYSON METHOD DESIGNS **THACHER PROPELLERS**

THACHER PROPELLER & FOUNDRY CORP.

THACHER STREET, ALBANY, N. Y.

OWNERS OF

American Screw Propeller Company of Philadelphia.



SUPERHEAT and DRAFT

The fire-tube superheater offers no increased resistance to draft and necessitates no increased air pressure. Being in the hot gas path, it presents less than one-half the amount of surface to the current of gases than do waste gas type superheaters. Its surfaces are smooth and offer no lodging place for soot and cinders.

The uptake is not obstructed. Flues are blown as easily and in exactly the same manner as in non-superheater boilers. The fire-tube superheater introduces no difficult operating problems and it's location in the hot gas path instead of in low temperature waste gases insures constant dependable superheat and avoids deterioration from corrosion.

The result—a fuel saving of from 12 to 20%.

More than 1,800 vessels are proving these statements every day.

LOCOMOTIVE SUPERHEATER COMPANY

MARINE SUPERHEATERS

New York Chicago



Whenever you need screw-cutting tools remember this trade-mark

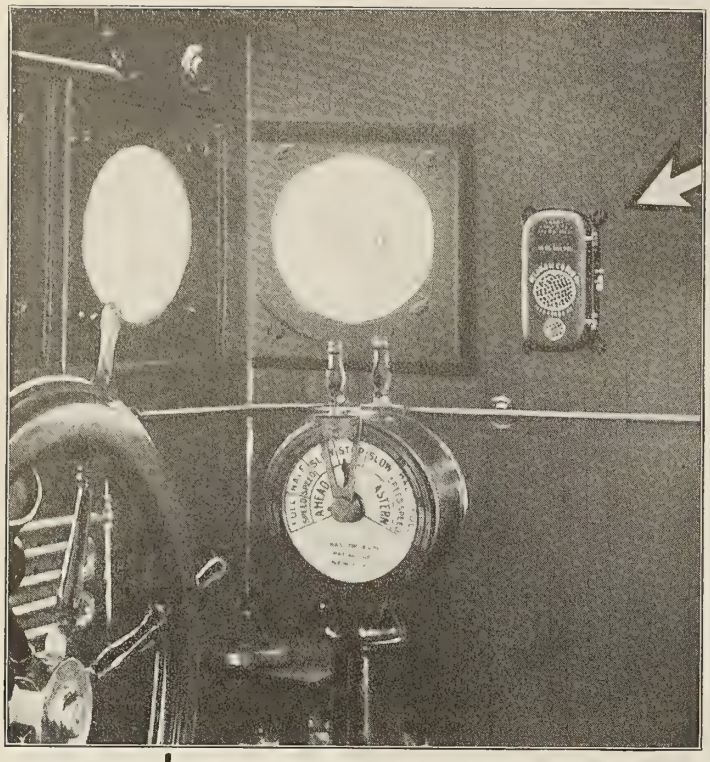
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KLAXOPHONE

The Loud Speaking Telephone

YOU can install a Klaxophone equipment (Klaxon-Stentor Telephone) in a fraction of the time required for a voice tube installation. Even if a ship can stay in port only a day or two there is always time enough to equip it with Klaxophones. And if a ship stayed in port a month---you could not equip it with a quicker, safer or more reliable means of communication.

KLAXON COMPANY

INDUSTRIAL DIVISION

Intercommunication and Signal Engineers

METROPOLITAN TOWER NEW YORK, N. Y.

K-105



The Safest Way To Buy Bolts and Nuts

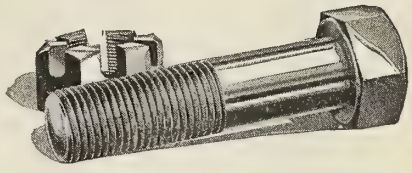
All makes of bolts and nuts may look equally good, if heaped together in a tote box. But there can be all the difference in the world in the way they perform their office.

When nuts and bolts work loose, fracture, strip their threads—there is more at stake than the cost of replacing them.

In the service given by these little pieces of metal you can see the wide variation in methods of manufacture.

This company was the pioneer maker of cold punched steel nuts and cold headed bolts. Since 1845 it has held the leadership in one of the world's most vital industries. In this time we have developed manufacturing facilities which have no duplicate in any other plant.

Empire Bolts and Nuts are used by every navy yard in the country, practically all the big shipbuilders, the aircraft board, quartermaster's department—wherever thoroughgoing quality is demanded.

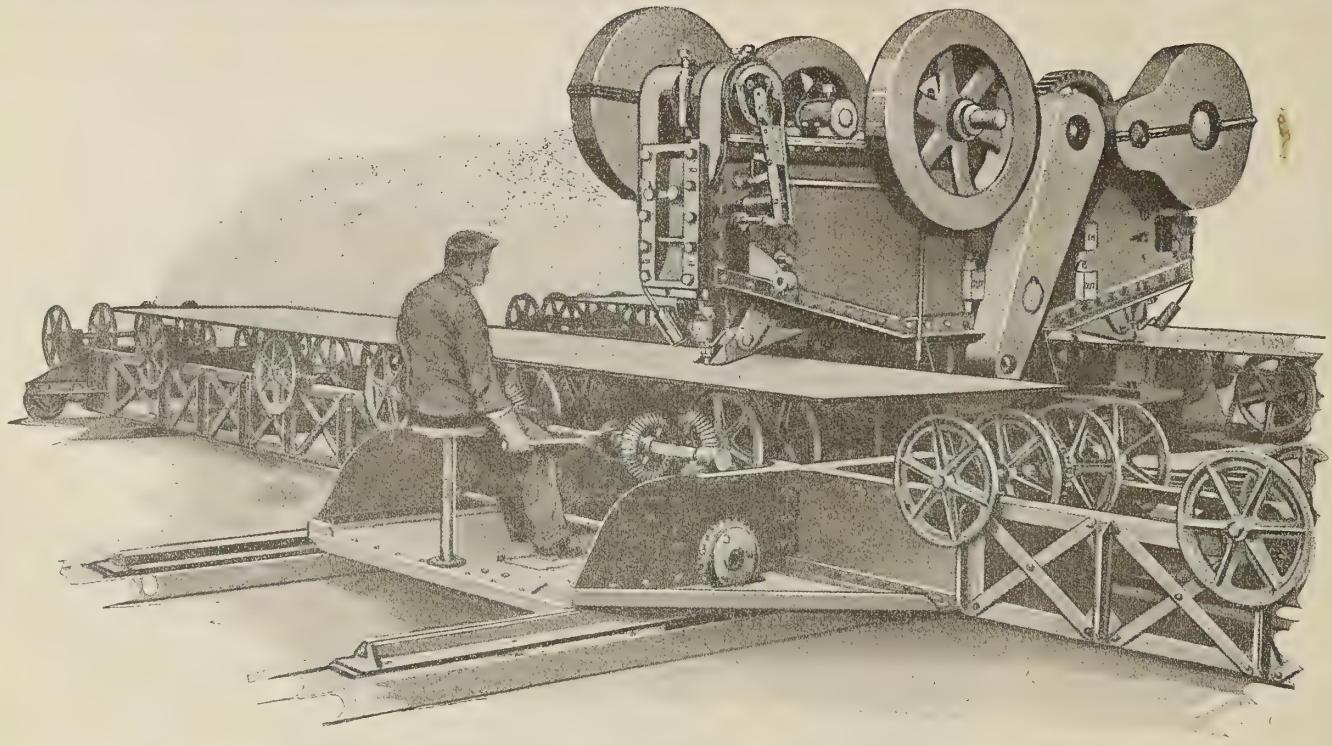


Know from whom you are buying—no other way is safe. And bear this in mind—every Empire Bolt and Nut is **guaranteed.**

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PEMBERWICK, CONN PORT CHESTER, NEW YORK ROCK FALLS, ILLINOIS

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The Lysholm Patented Plate Punch Table

Punching 4000 Holes Per Day in Steel Plates.

Rapid production in punching holes in boiler plate is made possible on this machine by means of a roller table. Lateral and sidewise movements are under the lever control of the operator. ¶The tables are built with roller bearings to facilitate rapid movement of the work. ¶Plates up to 30 ft. x 8 ft. form ¼ in. to 1⅛ in. in thickness may be handled readily. ¶Various shipyards and plate shops have reported records that average 4000 holes per nine-hour day. 6700 holes in a nine-hour day is a common occurrence. Full information on request.

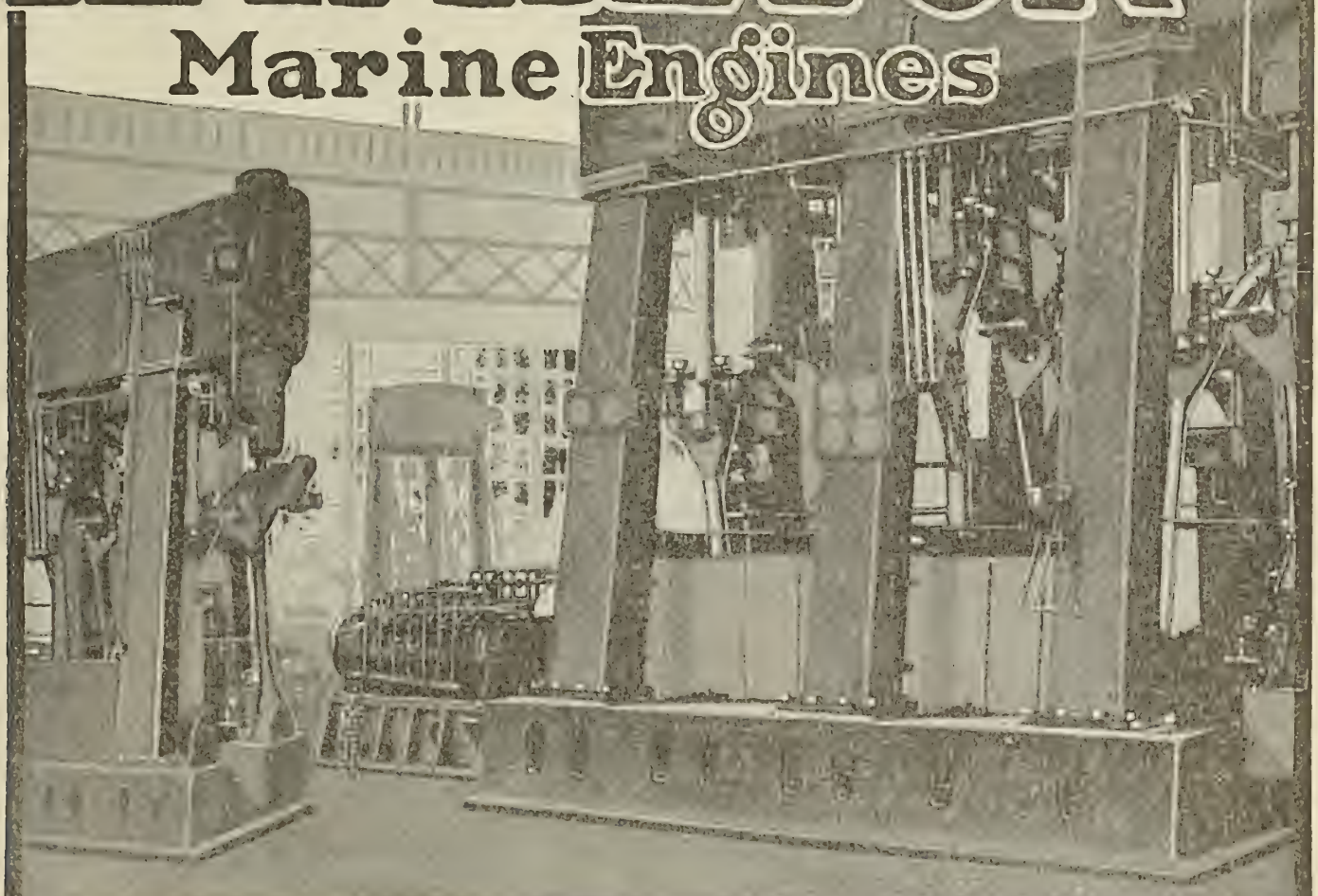
Companies Now Using or Having on Order Lysholm Plate Punch tables

American International Corp.	Hog Island, Phila., Pa.
The Atlantic Corporation	Portsmouth, N. H.
Atlantic Refining Co.	Philadelphia, Pa.
Balto. Dry Dock & Shipbuilding Co.	Baltimore, Md.
Bayles Shipyard, Inc.	Pt. Jeff., L.I., N.Y.
Bethlehem Steel Company	Sparrows Point, Md.
Birmingham Steel Corp.	Birmingham, Ala.
Bros Boiler & Mfg. Co., Wm.	Minneapolis, Minn.
The Brownell Co.	Dayton, Ohio
Camden Iron Works	Camden, N. J.
Carnegie Steel Co.	Waverly, N. J.
Carnegie Steel Co.	Balto., Md.
Carolina Shipbuilding Corp.	Wilmington, N. C.
Case Crane & Engineering Co.	Columbus, Ohio
Chandler & Taylor Co.	Indianapolis, Ind.
Chester Shipbuilding Co.	Chester, Pa.
Chickasaw Shipbuilding Co.	Mobile, Ala.
Coughlan & Sons, J.	Vancouver, B. C.
A. H. Cox & Co.	Seattle, Wash.
Dayton Steel Construction Co.	Dayton, Ohio
Detroit Shipbuilding Co.	Detroit, Mich.
Robert Dollar Co.	New York City
John Eichley, Jr., Co.	Pittsburgh, Pa.
Erickson Engineering Co.	Seattle, Wash.
Farrar & Trefts	Buffalo, N. Y.
Federal Shipbuilding Co.	New York, N. Y.
Foundation Co.	New Orleans, La.
Foundation Co.	Savannah, Ga.
Ferguson Steel & Iron Co.	Buffalo, N. Y.
Gem City Boiler Co.	Dayton, Ohio
Great Lakes Engineering Co.	Detroit, Mich.
Great Lakes Engineering Co.	Ashtabula, Ohio
Groton Iron Works	Groton, Conn.
Hammond Iron Works	Warren, Pa.
Hong Kong & Whampoa Dockyard Co.	Hong Kong, China
McAleenan Bros. Co.	Pittsburgh, Pa.
McClintic-Marshall Co.	Pittsburgh, Pa.
The Massillon Bridge & Struct.	Massillon, Ohio
Merchants Shipbuilding Co.	Bristol, Pa.
Merril-Stevens Co.	Jacksonville, Fla.
Mitsubishi Goshi Kaisha	Tokio, Japan
Morgan Engineering Co., The	Alliance, Ohio
Navy Yard	Brooklyn, N. Y.
New Jersey Shipbuilding Co.	Gloucester, N. J.
Newport News Shipbuilding Co.	Newport News, Va.
Newburgh Ship Yard	Newburgh, N. Y.
New York Shipbuilding Corp.	Camden, N. J.
Nitta Steamship Co.	Kobe, Japan
Norway Pacific Const. & Drydock Co.	Everett, Wash.
Osaka Iron Works	Tokio, Japan
Penn Bridge Co.	Beaver Falls, Pa.
Pennsylvania Engineering Wks.	New Castle, Pa.
Pennsylvania Shipbuilding Co.	Gloucester, N. J.
Pennsylvania Steel Export Co.	Philadelphia, Pa.
Pittsburgh-Des Moines Steel Co.	Pittsburgh, Pa.
Pressed Steel Car Co.	Pittsburgh, Pa.
Petroleum Iron Works, of Ohio.	Sharon, Pa.
Pusey & Jones Company	Wilmington, Del.
Ralston Steel Car Co.	Columbus, Ohio
The Reeves Bros. Co.	Alliance, Ohio
Riter-Conley Mfg. Co.	Pittsburgh, Pa.
Standard Car Construction Co.	Sharon, Pa.
Standard Steel Car Co.	Butler, Pa.
G. M. Standifer Const. Co.	Vancouver, Wash.
Sun Shipbuilding Co.	Chester, Pa.
Suzuki & Co.	Kobe, Japan
Tennessee Coal, Iron & R. R. Co.	Birmingham, Ala.
Toledo Shipbuilding Co.	Toledo, Ohio
Vincennes Bridge Co.	Vincennes, Ind.
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Wallace Shipyard	No. Vancouver, B. C.
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And it is a matter of considerable pride to us that we are privileged to play a part in this important work.

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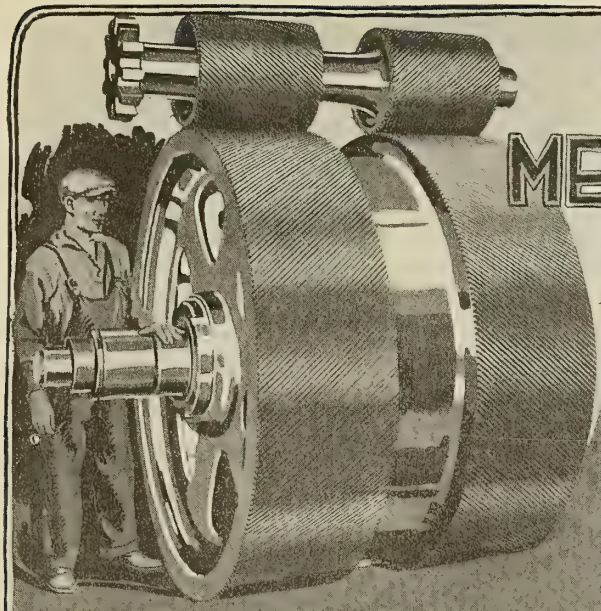
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QUIET OPERATION MEANS EFFICIENT GEARS



14 Knot, 12,000 ton boat equipped with De Laval geared turbines

The vessel shown above is one of the group { SOUTH BEND / MARICA / SOL NAVIS / EDELLYN

of 12,000-ton twin-screw, 14 knot sister ships each of which is equipped with two 2500-HP. De Laval compound marine turbines driving the propellers through single gear reductions.

All of these vessels are in the transport service and the operation of the De Laval geared turbines has been characterised by high efficiency and exceedingly quiet operation.

Quiet operation of reduction gears is a point that is receiving more and more consideration from shipbuilders as quietness of operation means that the gears are correctly designed, correctly cut and correctly supported.

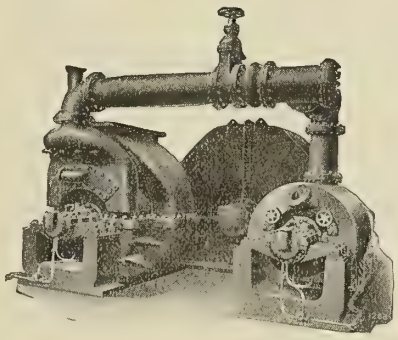
Noise in gears is also a serious fault from the operator's standpoint as noisy gears cause great inconvenience to the operating crews and make it very difficult to detect troubles that may occur in various parts of the engine room with auxiliaries which would be instantly noted if the gears operated quietly.

Either the high pressure or the low pressure element of each of the compound units described above can be operated upon high pressure steam and the vessel can be propelled by any one of the four turbines alone.

The combination of high and low pressure turbines also renders the unit suitable for high boiler pressure and high vacuum, which is conducive to high efficiency.

All parts of the turbine are easily accessible. Due to the absence of reciprocating and rubbing parts, packings, complicated valve gears, etc., comparatively little attention is required.

Let us give you the names of many other vessels equipped with De Laval gears. After investigation you will chose De Laval gears for your own boats. Ask for Special Publication No. 46.



De Laval 2500.HP. high and low pressure, two-pinion geared turbine. Propeller speed 110-RPM.

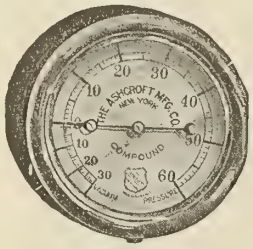
De Laval Steam Turbine Co.

400 Nottingham Way TRENTON, N. J.

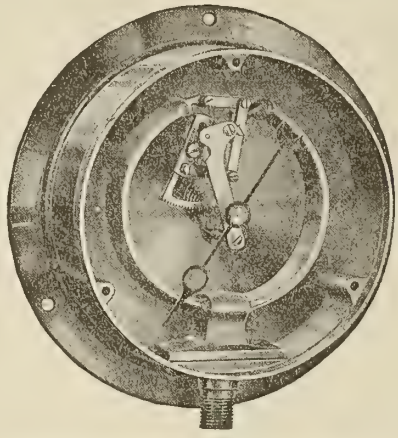
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ASHCROFT GAUGES

All Sizes

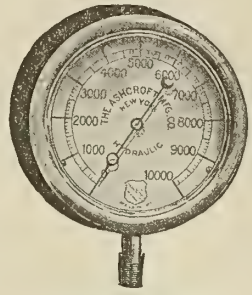


Ashcroft Iron or Brass Case Compound Gauge



Ashcroft Double Spring Pressure Gauge with Hard Geared Bushed Movement

All Sizes



Ashcroft Iron or Brass Case Hydraulic Gauge with tool steel spring

More Ashcroft Gauges are being installed on ships now building, than all other makes put together.

On battleships, destroyers, submarines, colliers, tankers, freighters, passenger ships—that is where Ashcroft gauges have been used for years, and where they are being used now.

The Ashcroft trade-mark on a gauge means that that gauge is properly designed—properly calibrated and what is equally important, is constructed of materials which long experience has proved will stand severe service.

The double spring pressure gauge shown on this page is particularly adapted for marine work. The double spring tends to minimize excessive movement of the hand, due to vibration and the heavy marine type movement will last for years even under severe service, without undue wear.

Ashcroft Gauges represent the best that it is now possible to build.

If it is ever possible to build better gauges, Ashcroft will be one of the first to do so.

Specify ASHCROFT GAUGES and see that you get them.

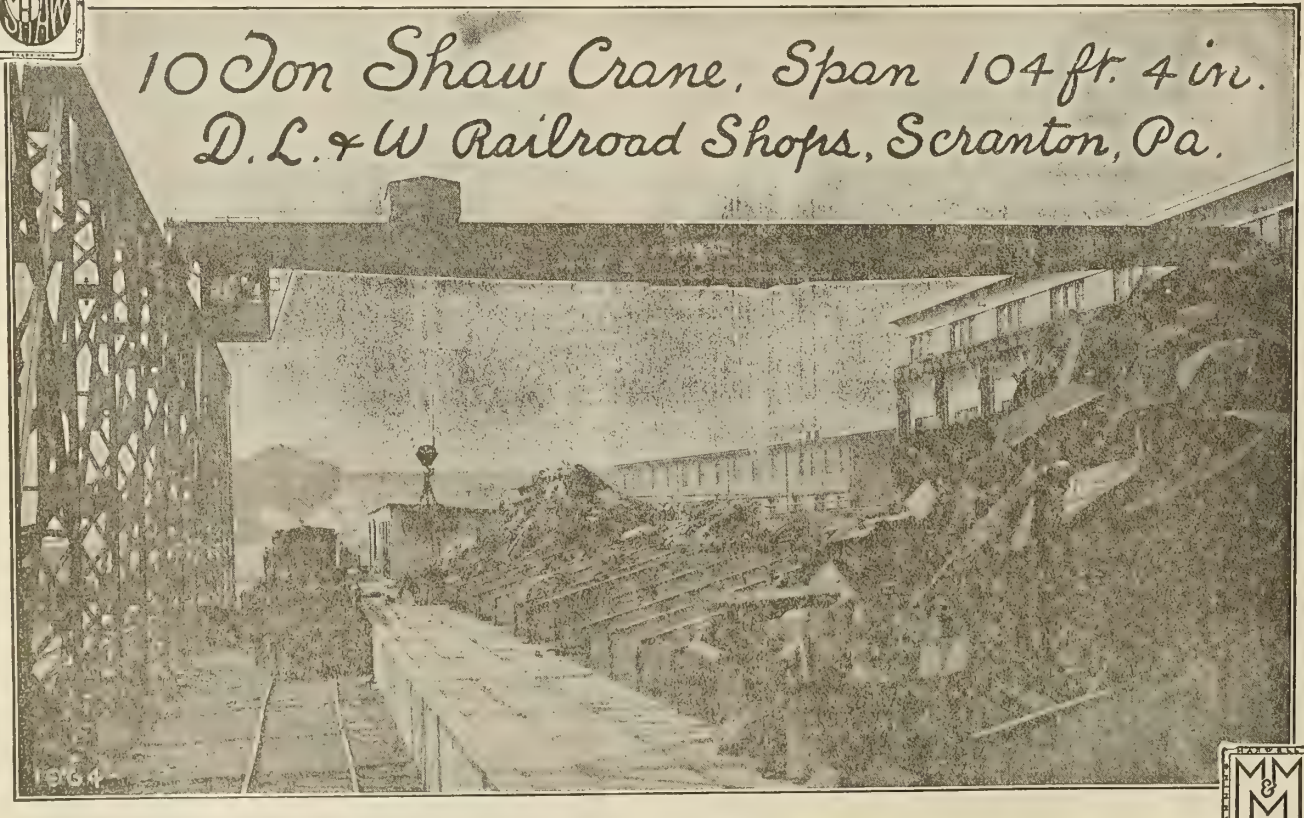
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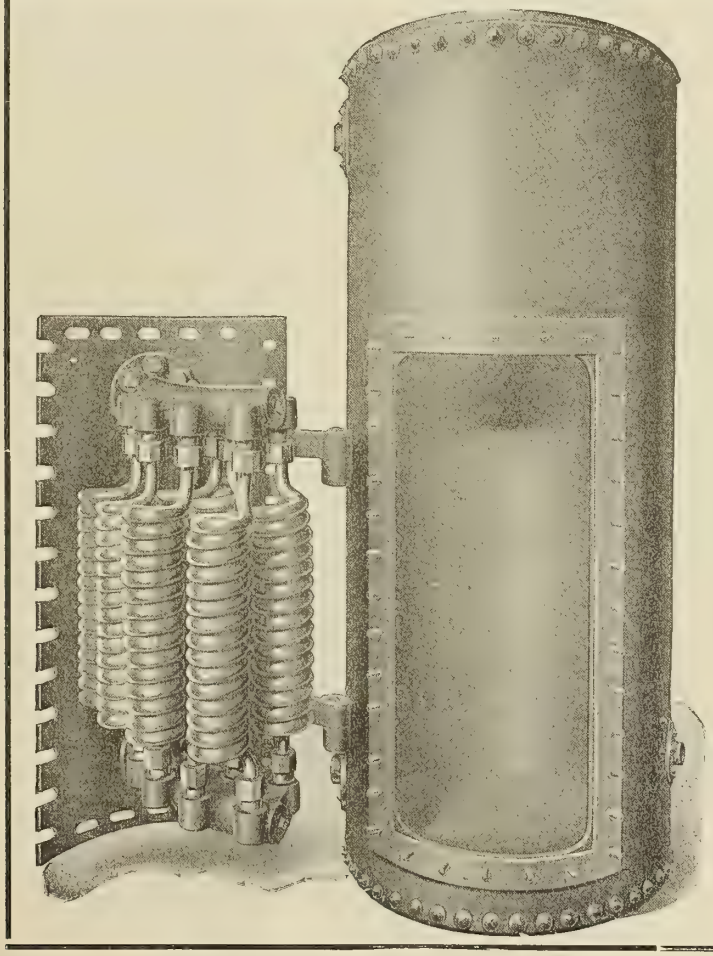
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In nearly every instance when there is an accident or mishap to a vessel, or a wreck caused by wave, storm or fire, good photographs are taken.

Or it may be that unusual repair jobs of some sort have attracted the photographer.

Such pictures are usually valuable, as well as instructive, as they illustrate the vicissitudes and chances of life at sea; or perhaps bring out some important point in the manner of salving a vessel or making repairs.

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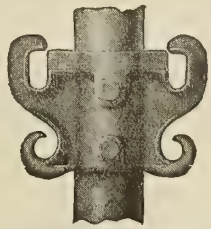
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"STANDEE BERTHS ONE OF OUR SPECIALTIES." We have built them in quantities for the largest shipbuilders in the U. S.

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A complete practical and efficient line is offered. "A berth to successfully meet every condition on board ship." Also brass and iron beds, mattresses and pillows.

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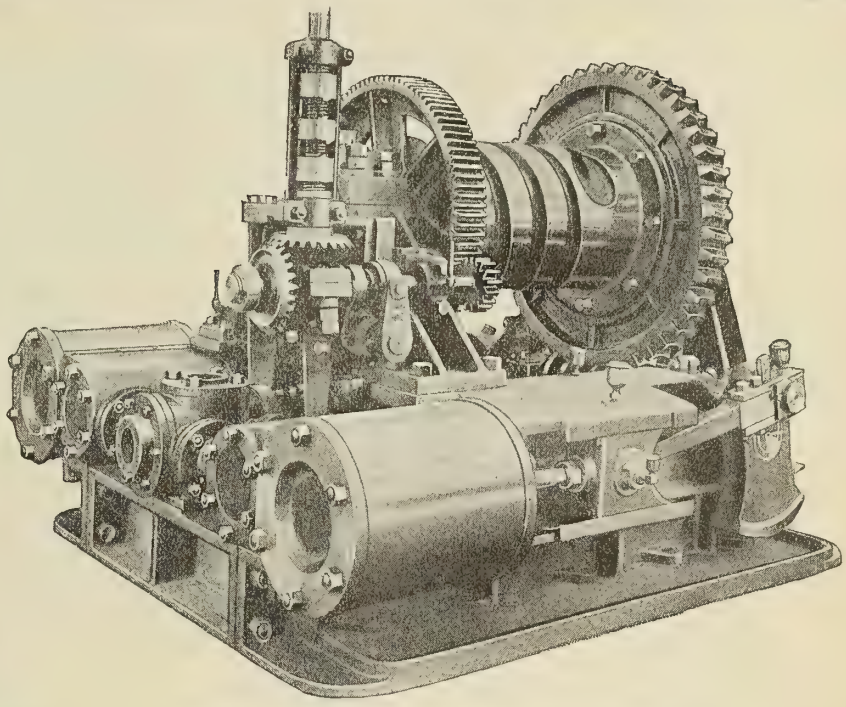
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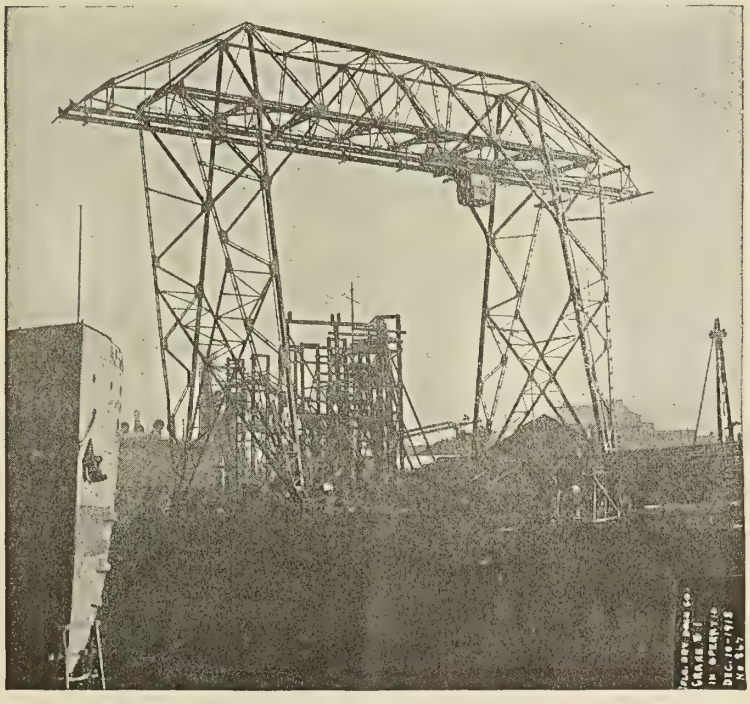


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Engineers and Manufacturers NEWARK, N. J.

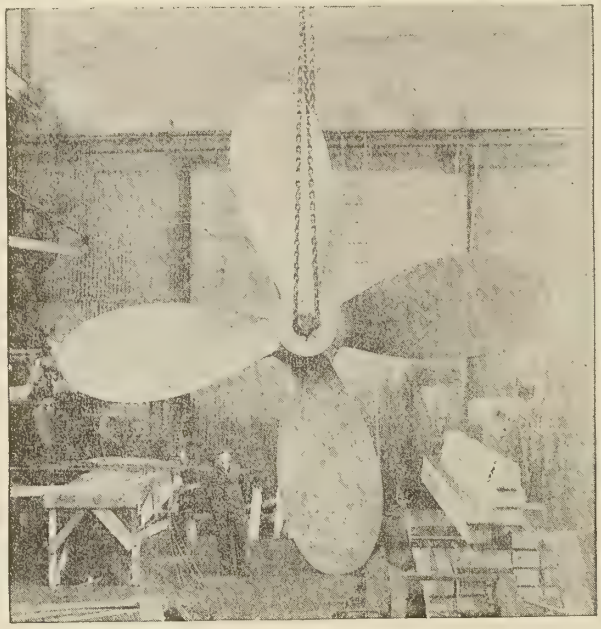
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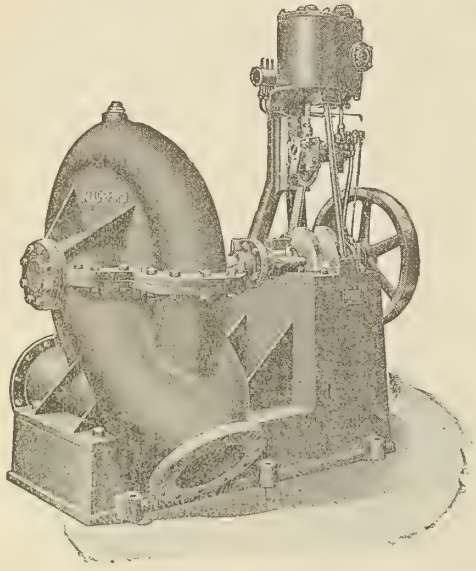


FIGURE 202

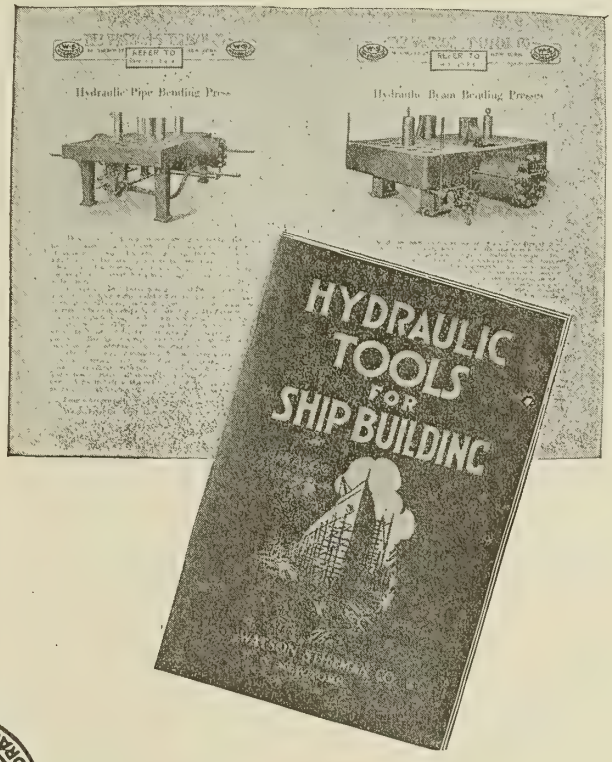
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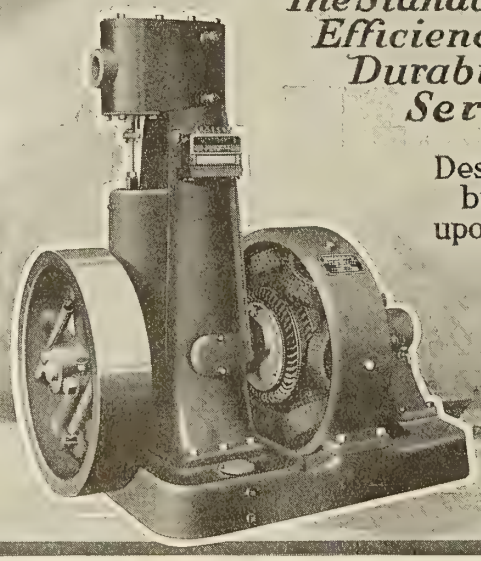
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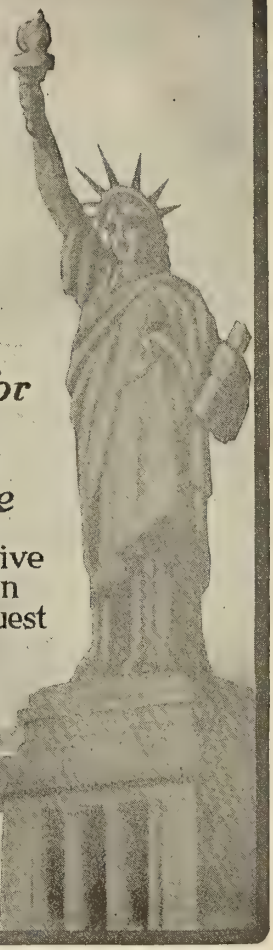
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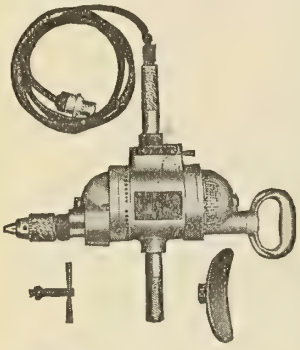






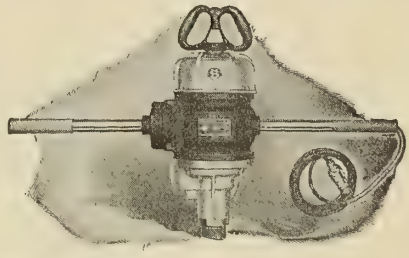
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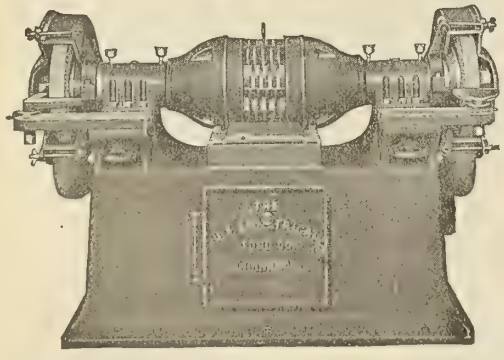
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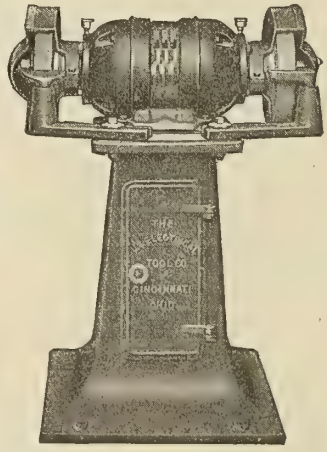
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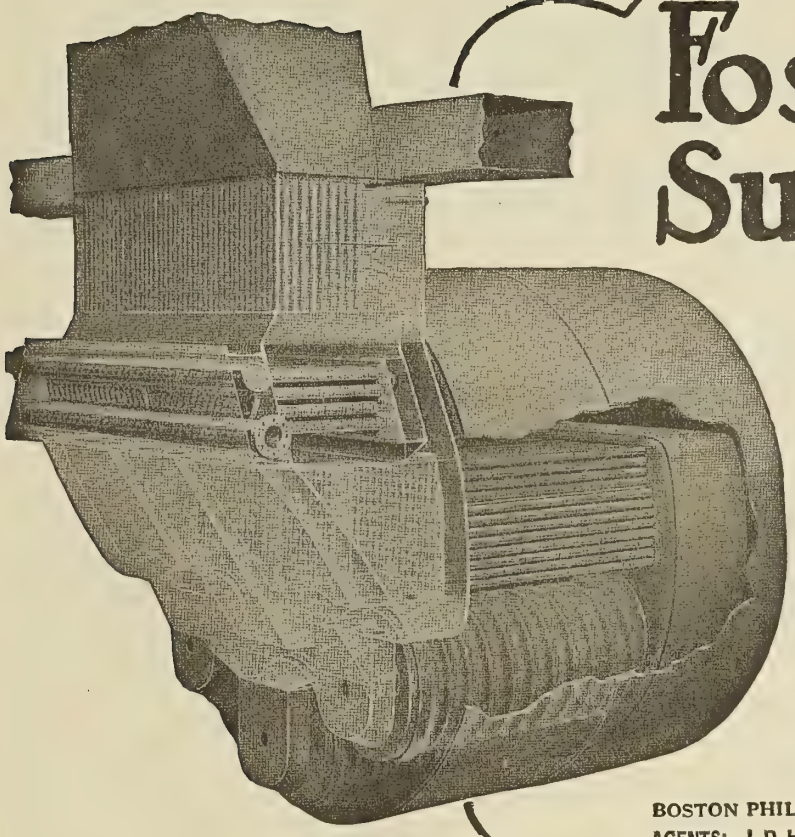
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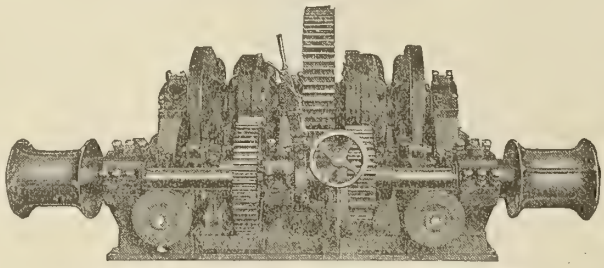
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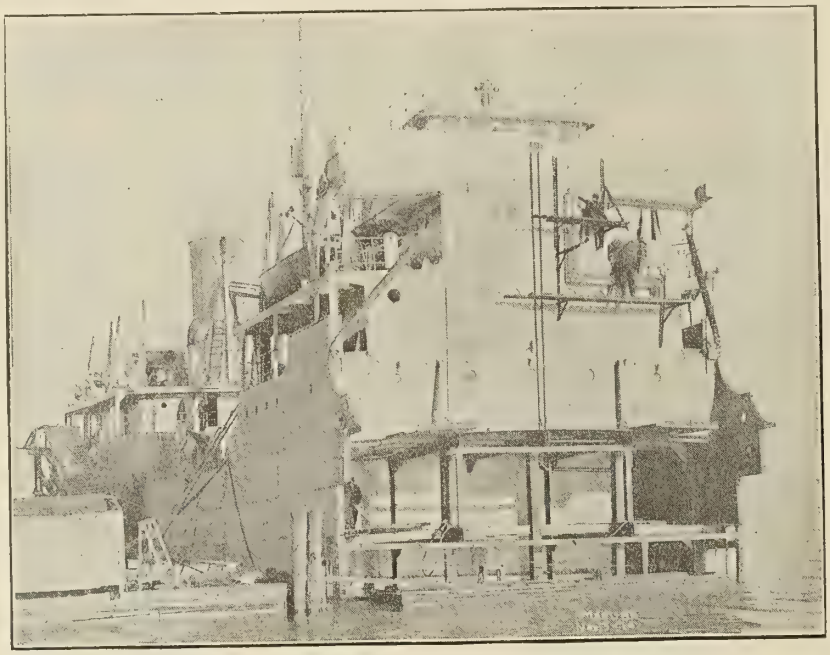
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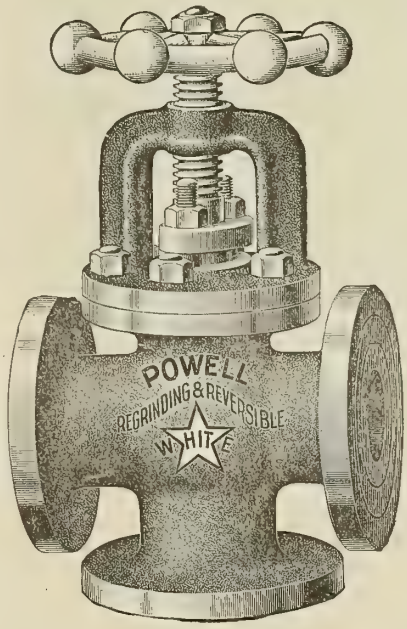
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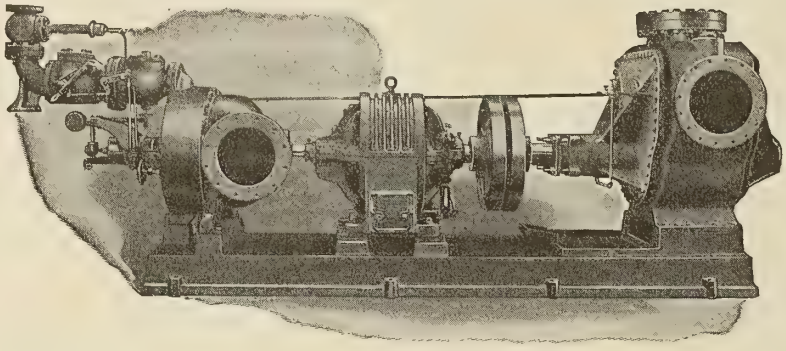
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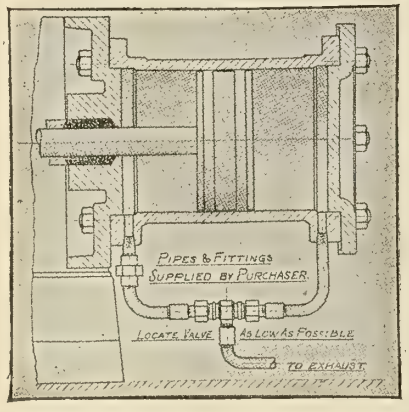
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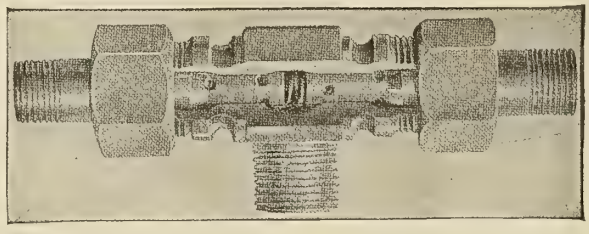
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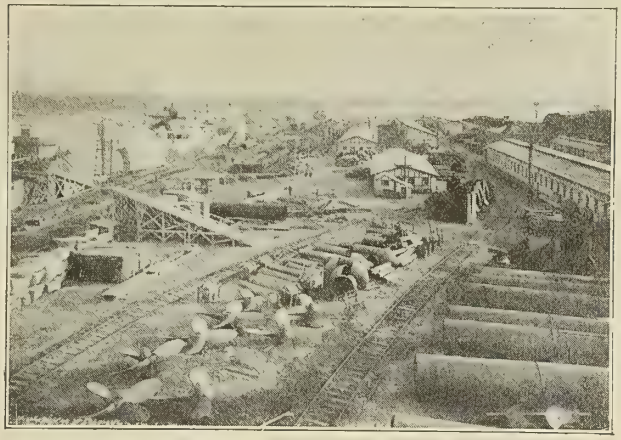
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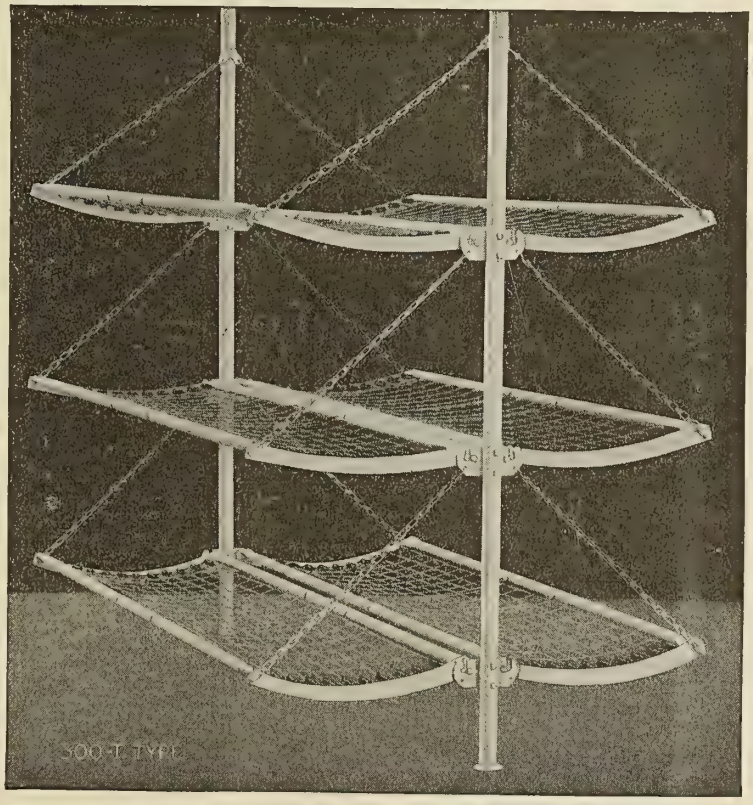
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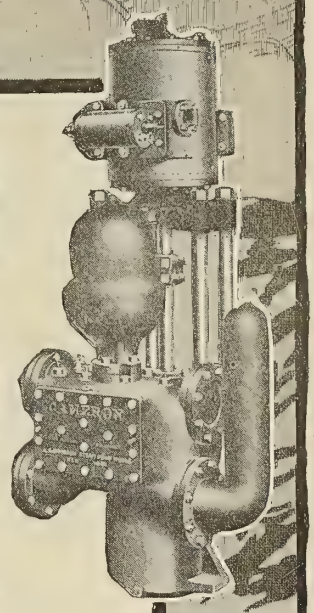


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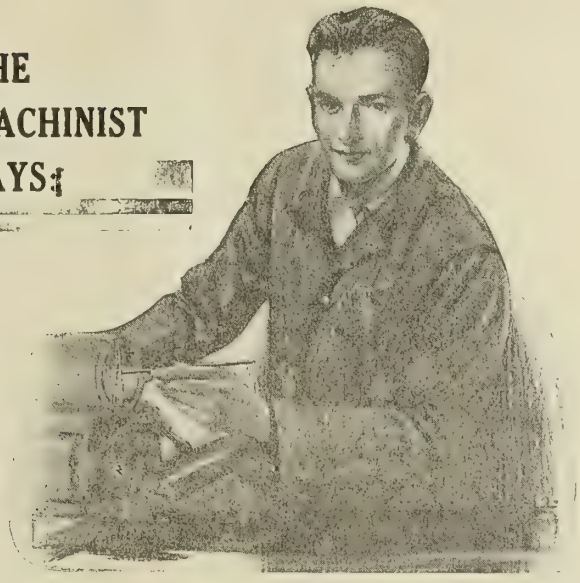
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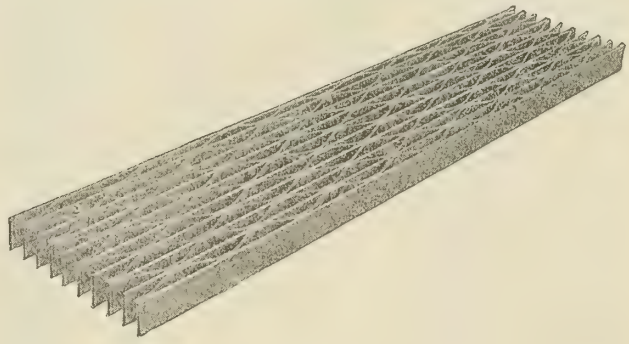


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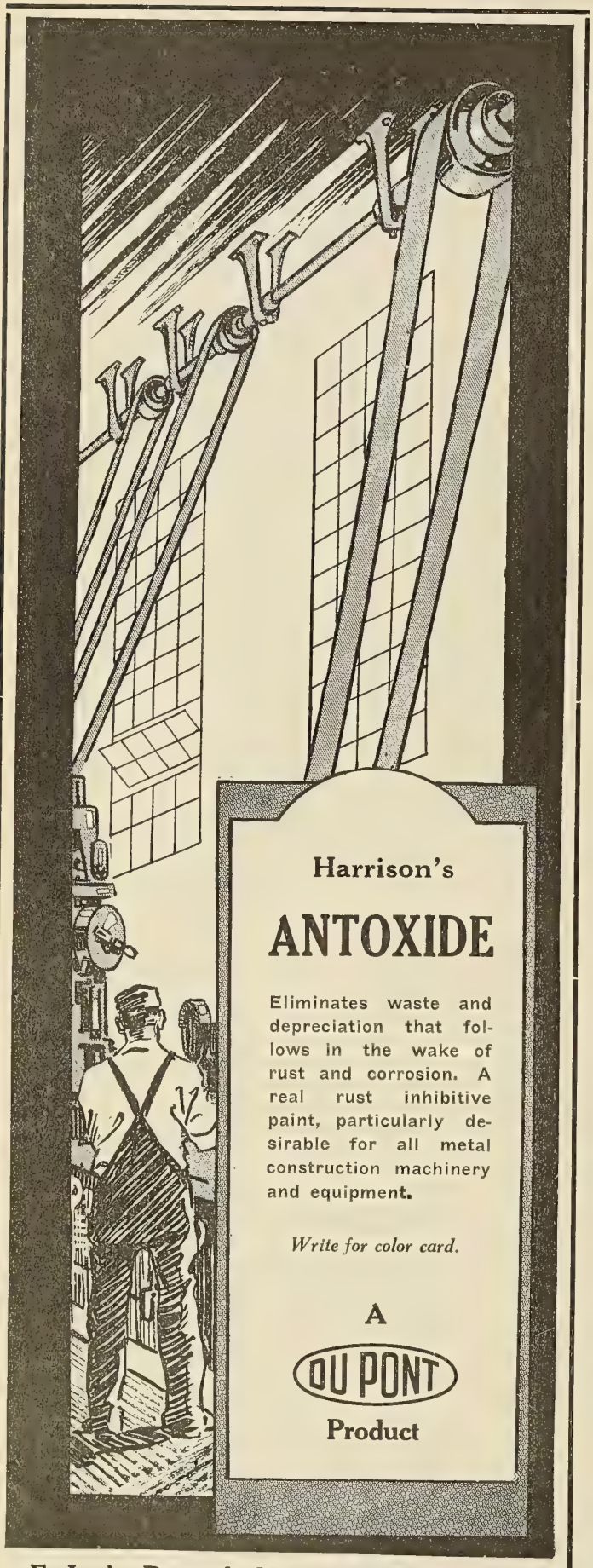
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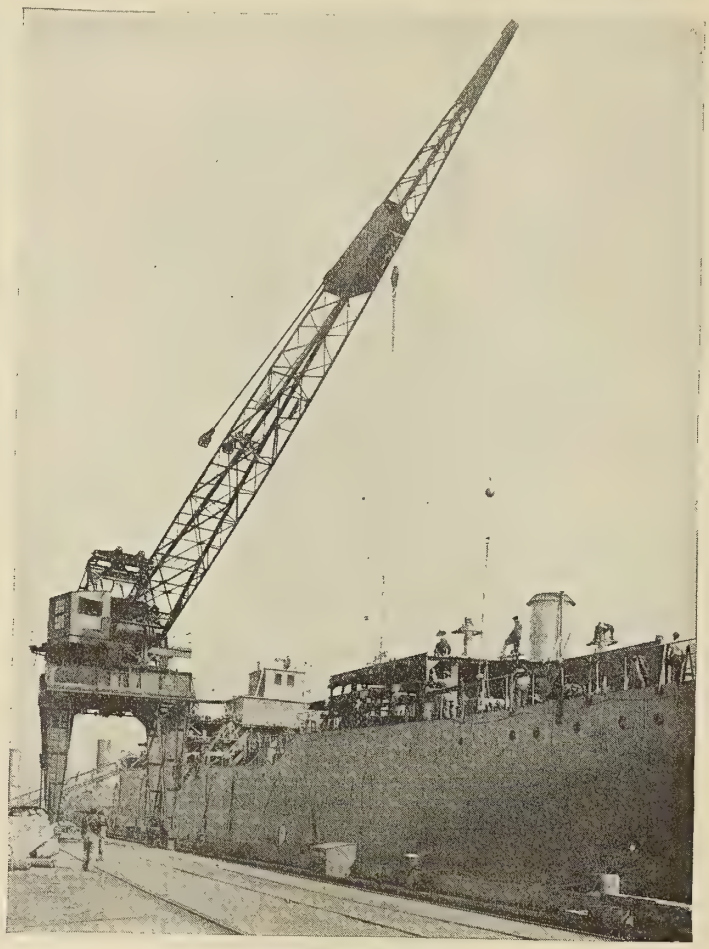
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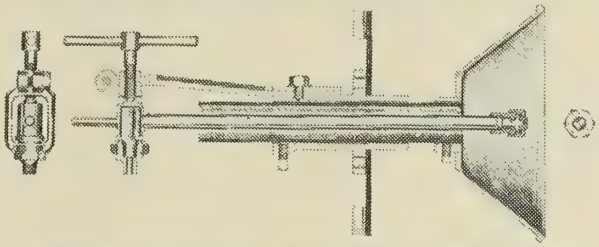
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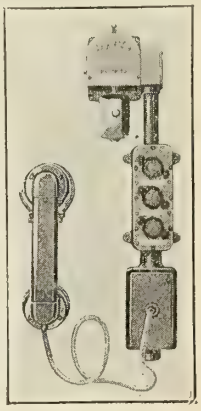
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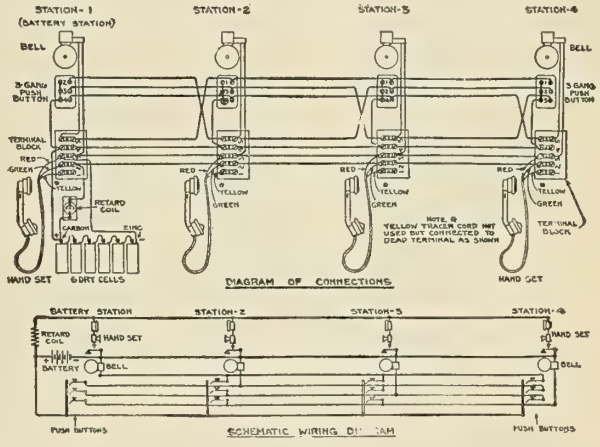
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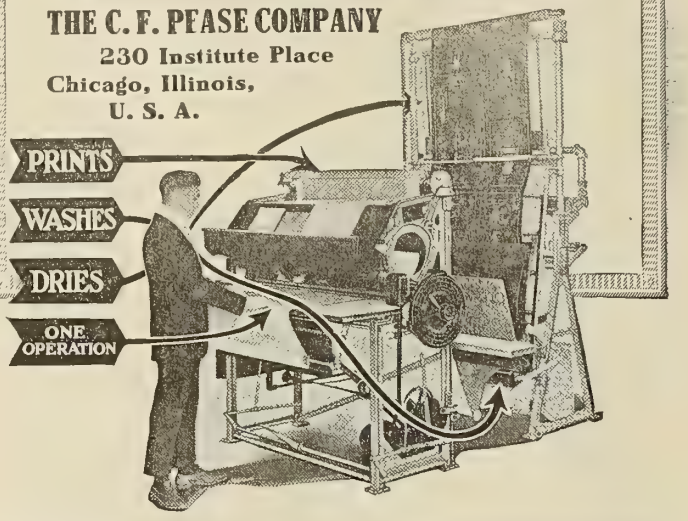
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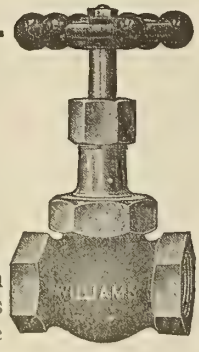
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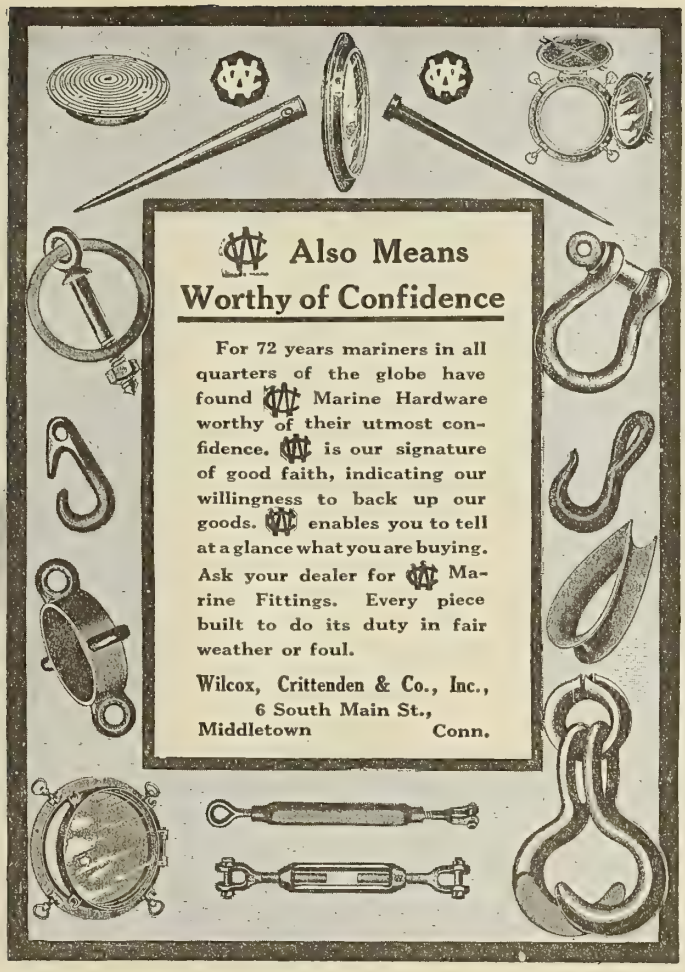
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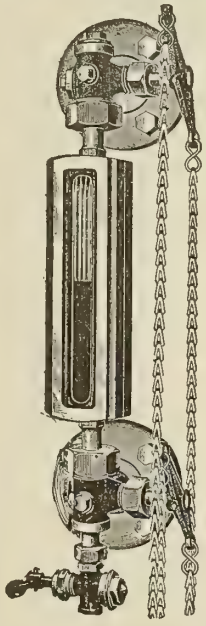
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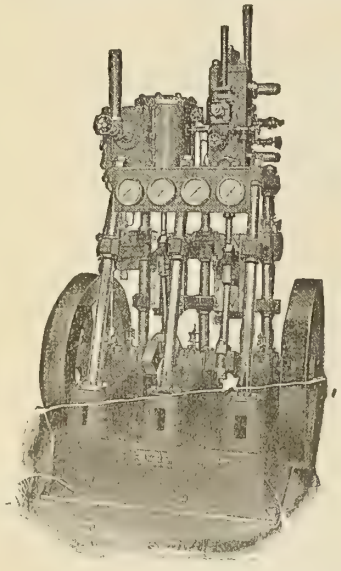
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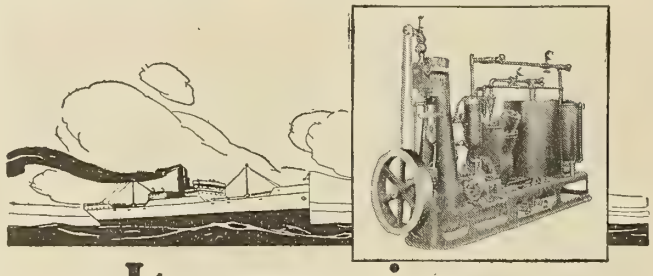
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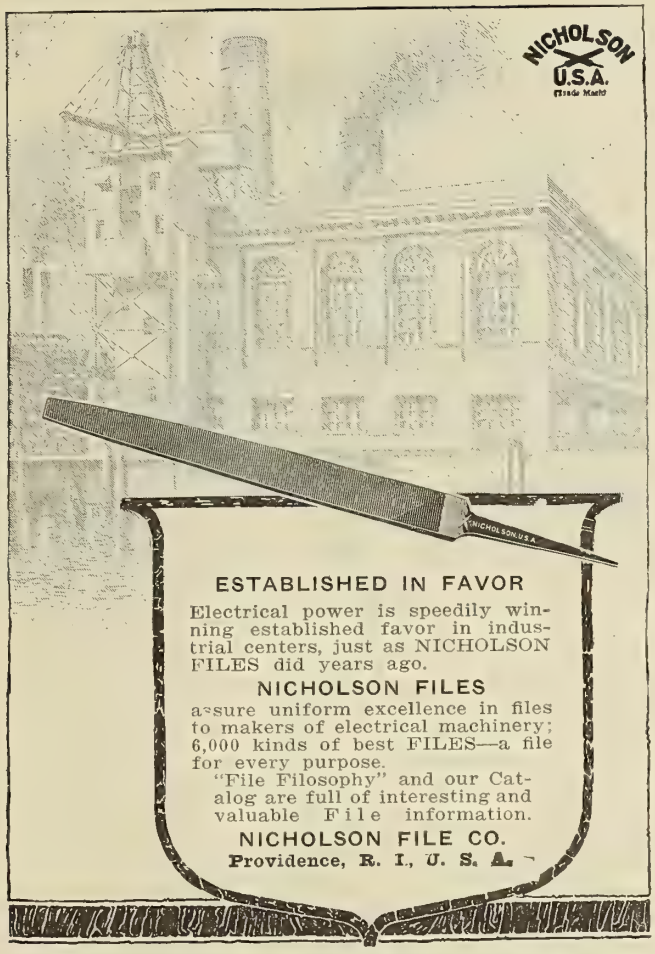
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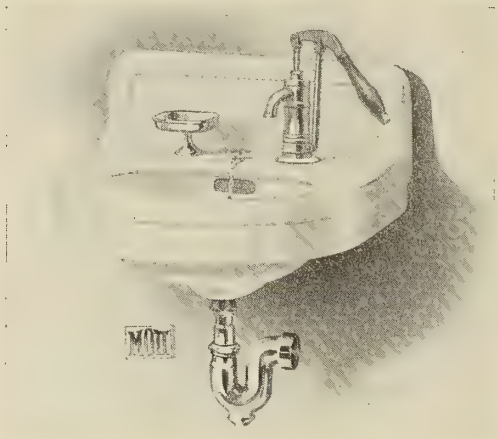
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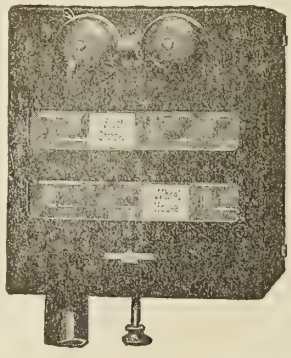
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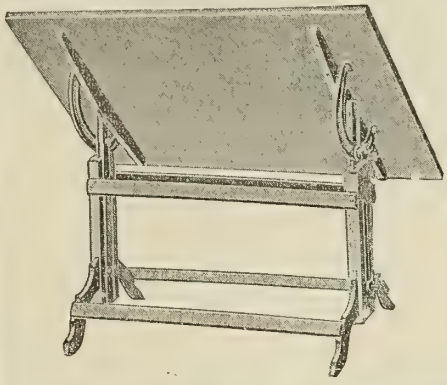
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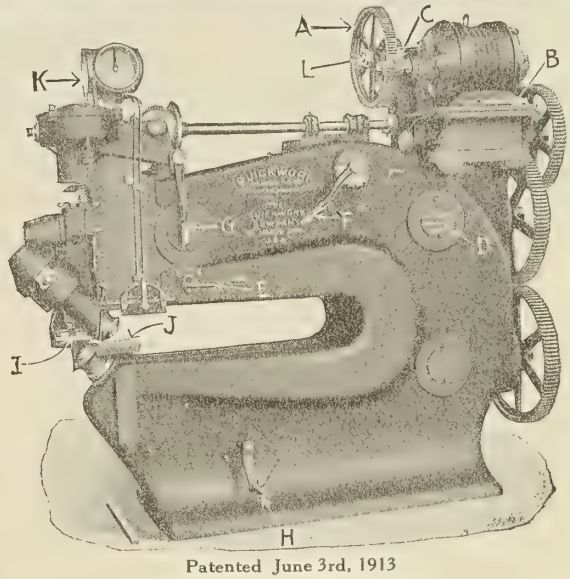
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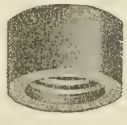
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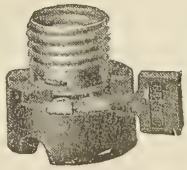
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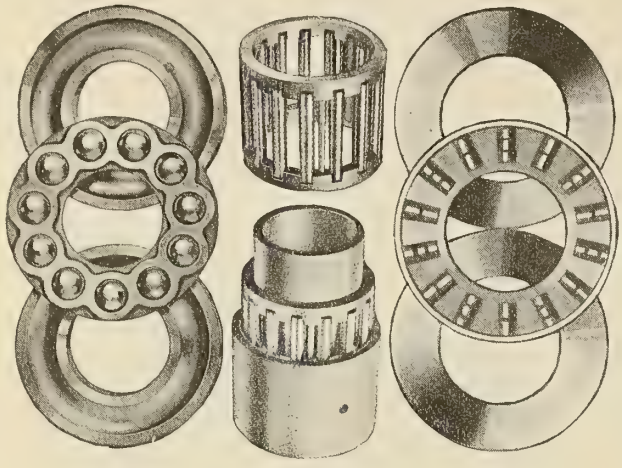
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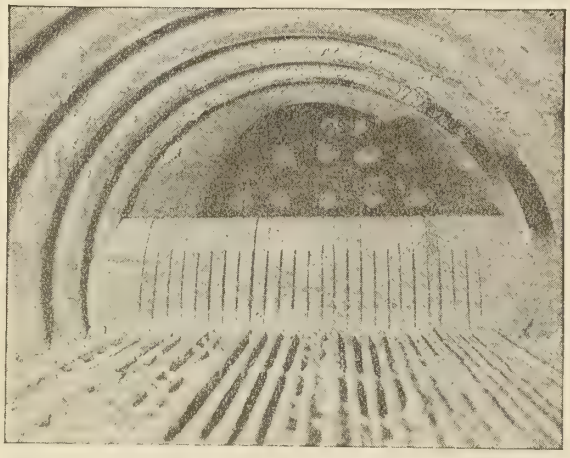
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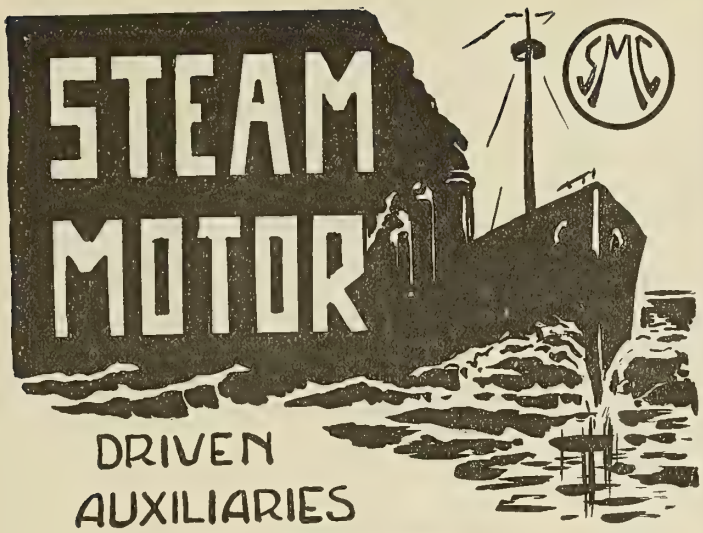
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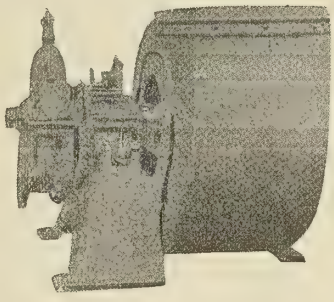
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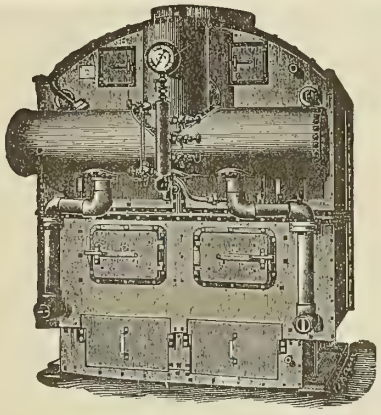
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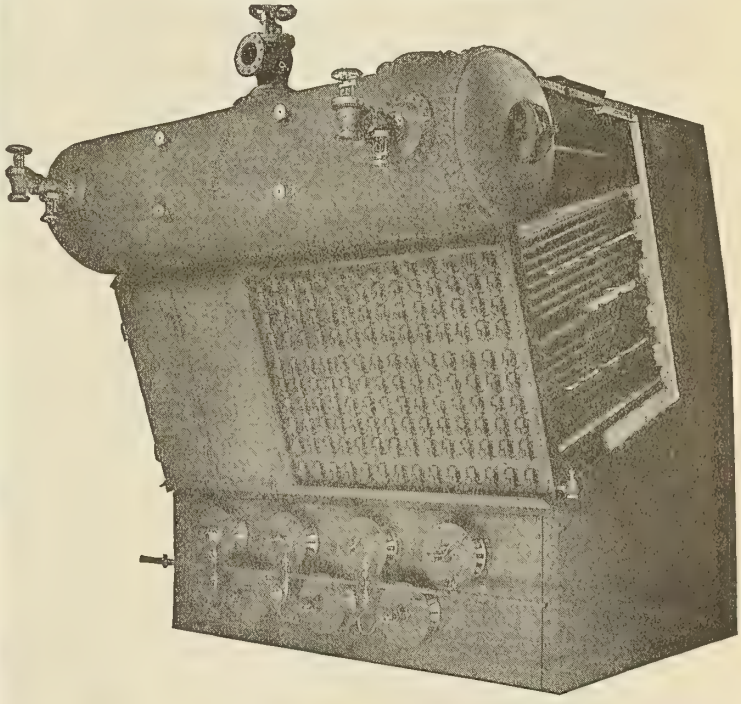
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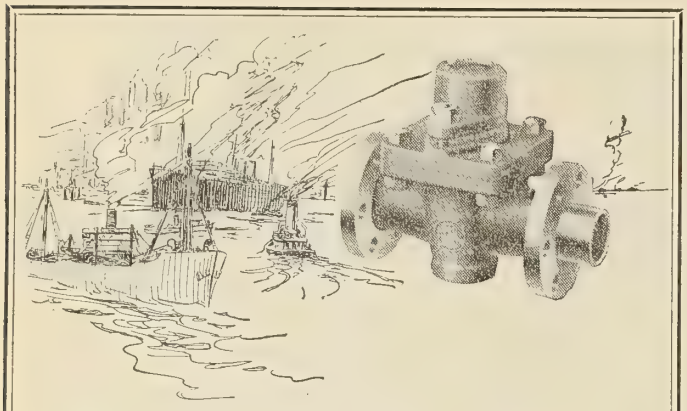
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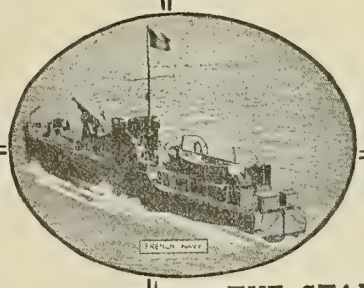
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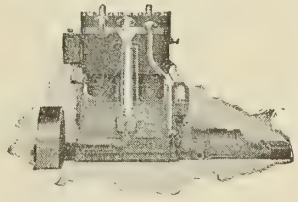


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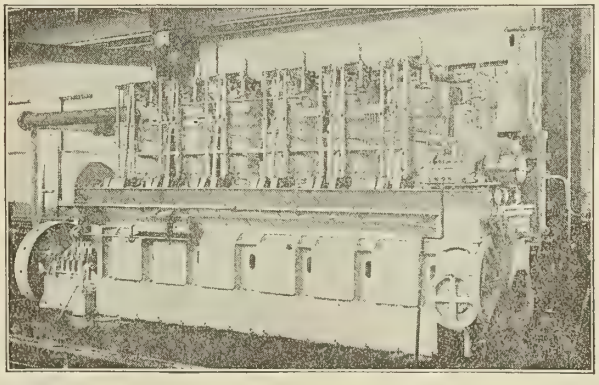
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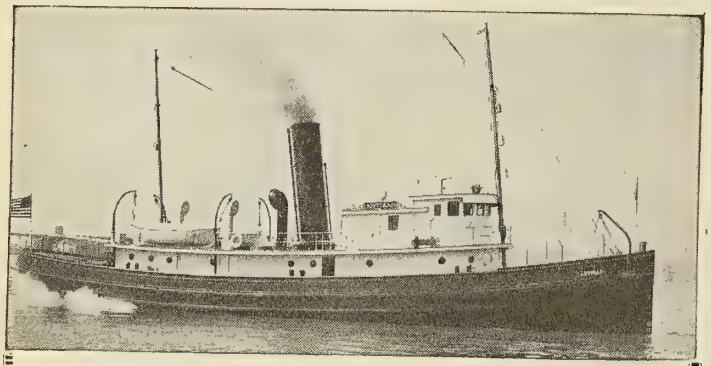
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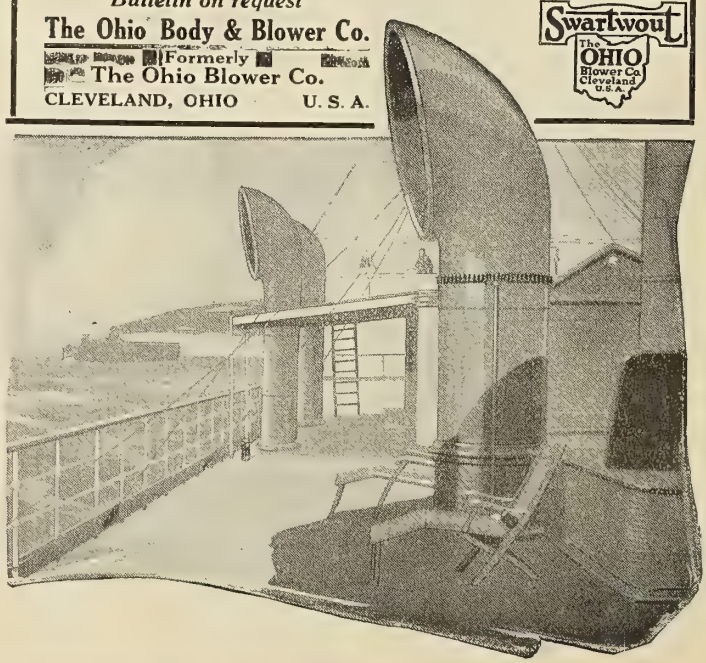
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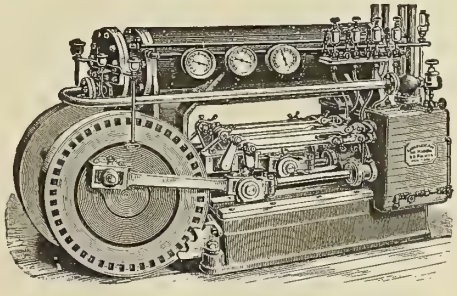
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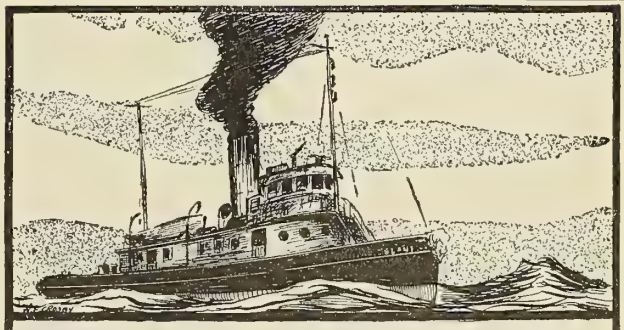


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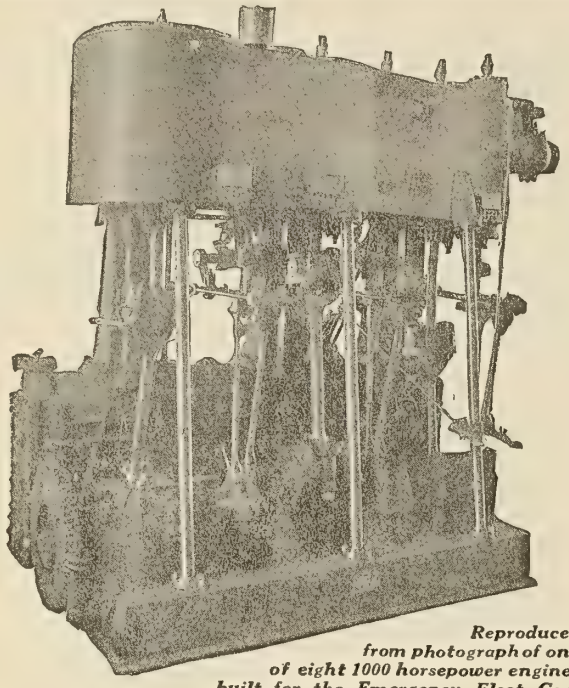
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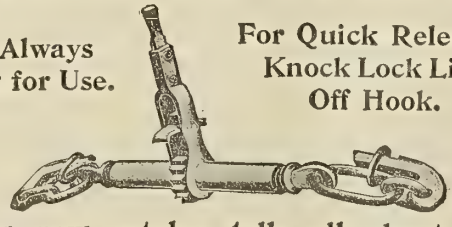
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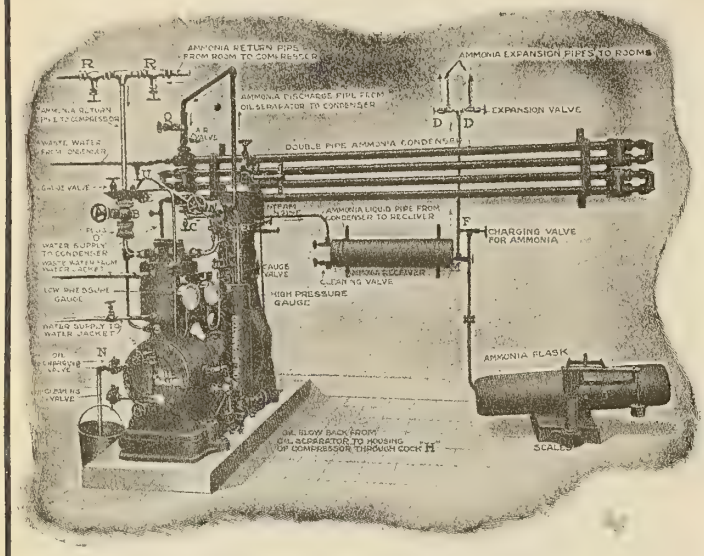
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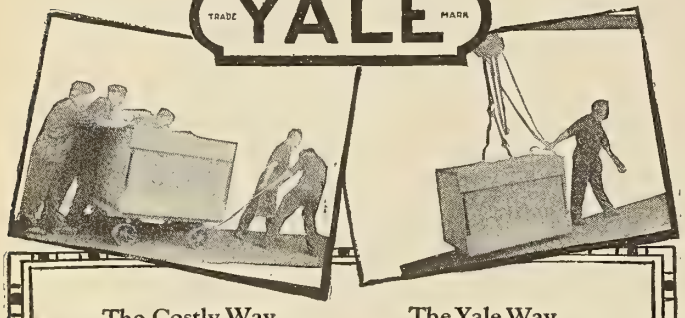
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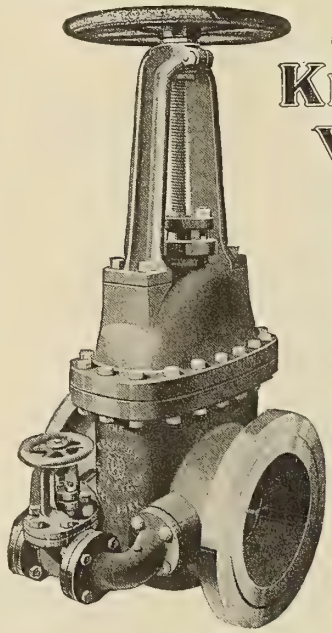
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State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. L. Sumner, who, having been duly sworn, according to law, deposes and says that he is the Business Manager of International Marine Engineering, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Aldrich Publishing Co., 6 East 39th St., New York.

Editor—H. H. Brown, 6 East 39th St., New York.

Managing Editor—H. L. Aldrich, 6 East 39th St., New York.

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2. That the owners are: (Give names and address of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Aldrich Publishing Co., 6 East 39th St., New York; H. L. Aldrich, 6 East 39th St., New York; M. G. Aldrich, 6 East 39th St., New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: A. I. Aldrich, Manville, Rhode Island; A. E. Lord, Mt. Washington, Md.; George Slate, Summit, N. J.; H. H. Brown, 6 East 39th St., New York.

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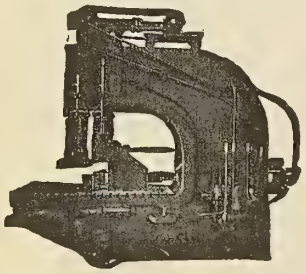
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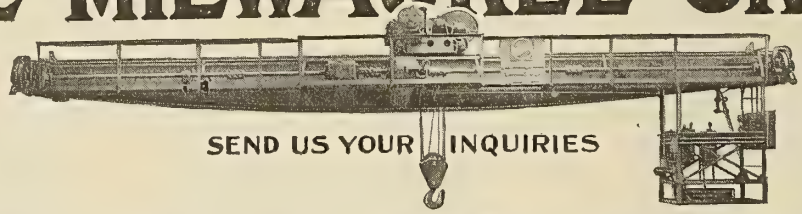
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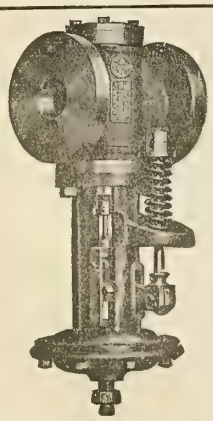
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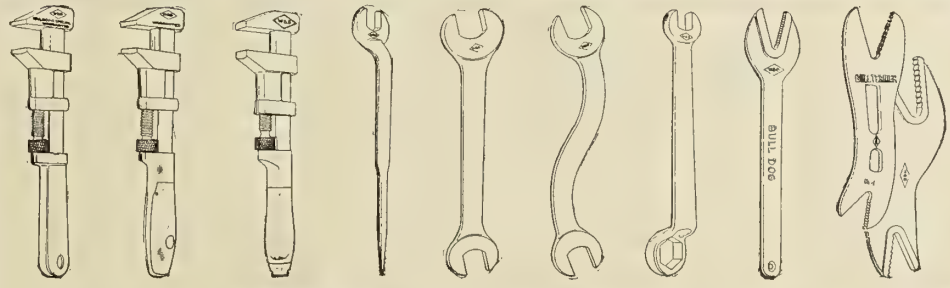
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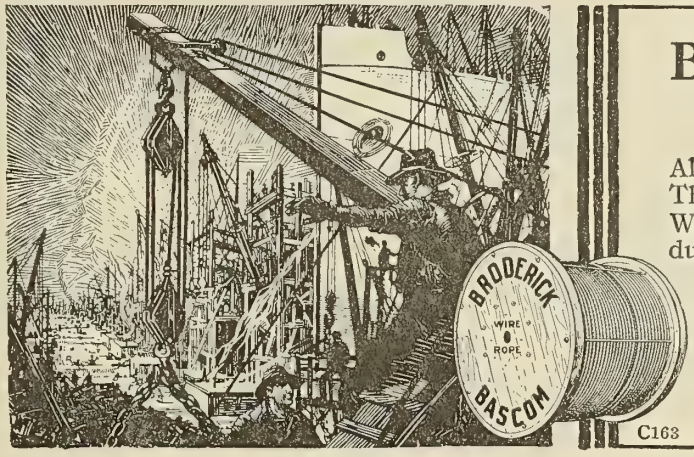
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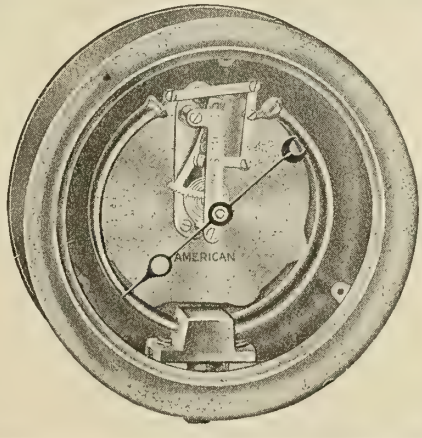


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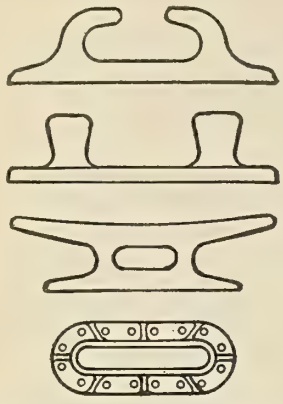
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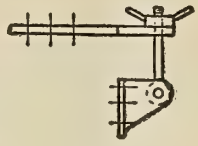
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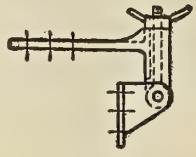
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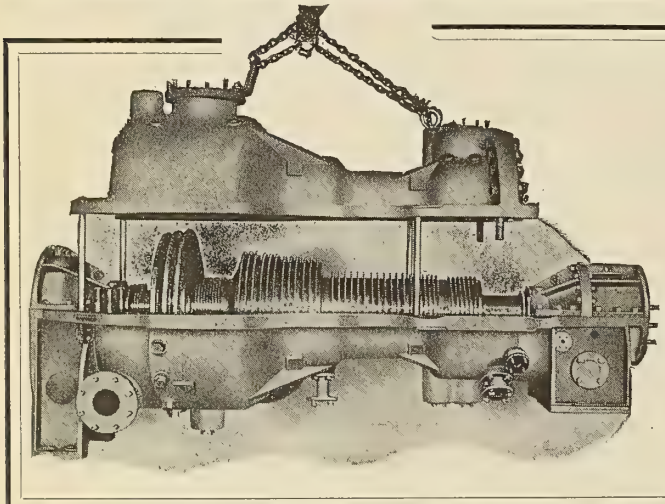




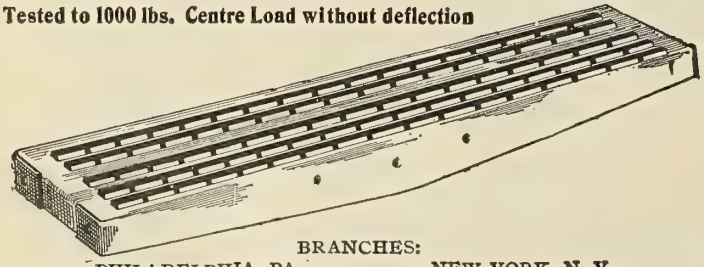
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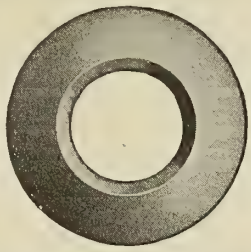


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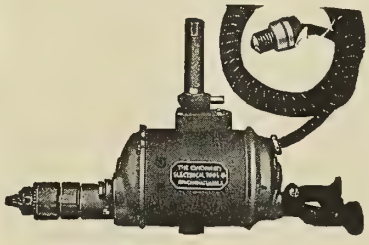
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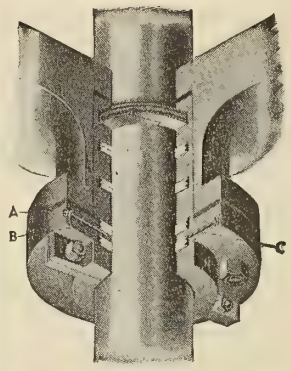
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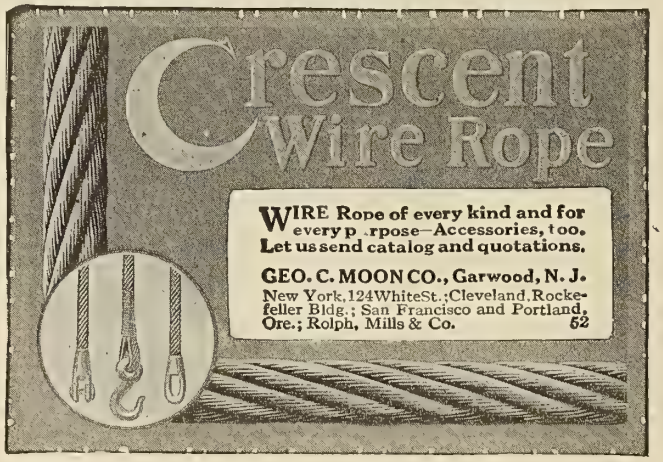
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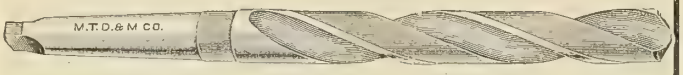
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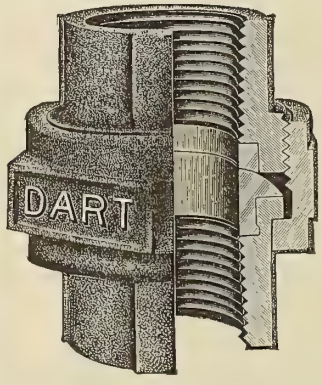
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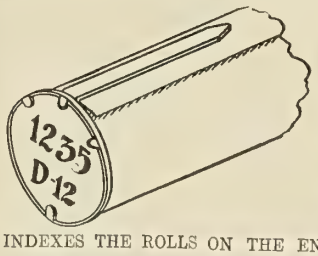
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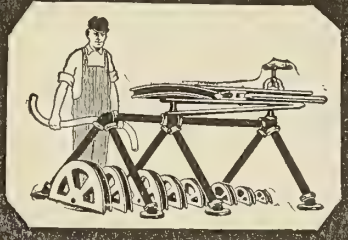
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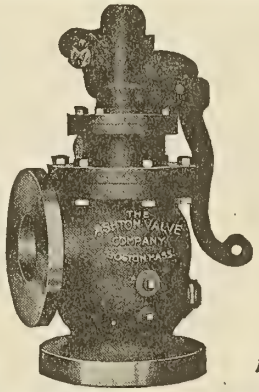
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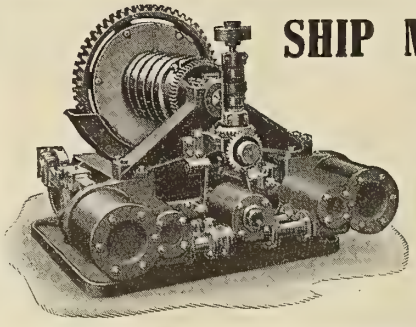
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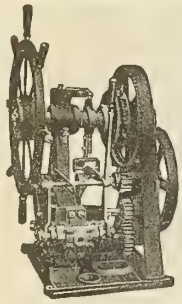
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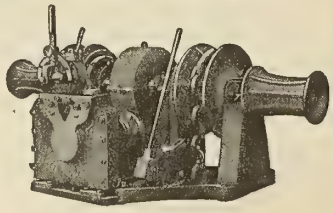
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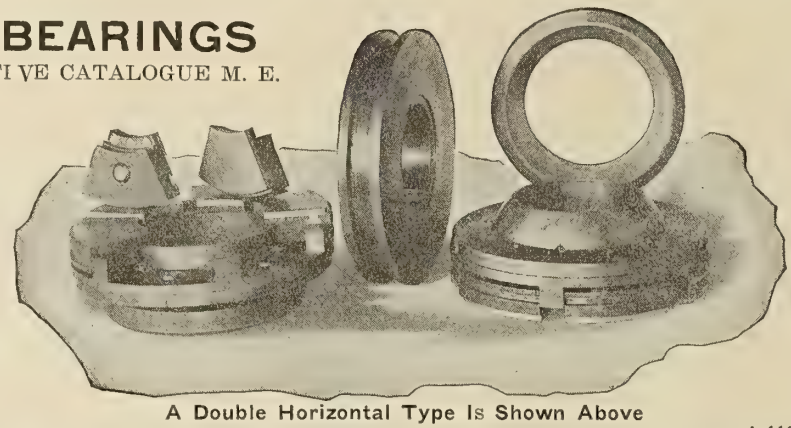
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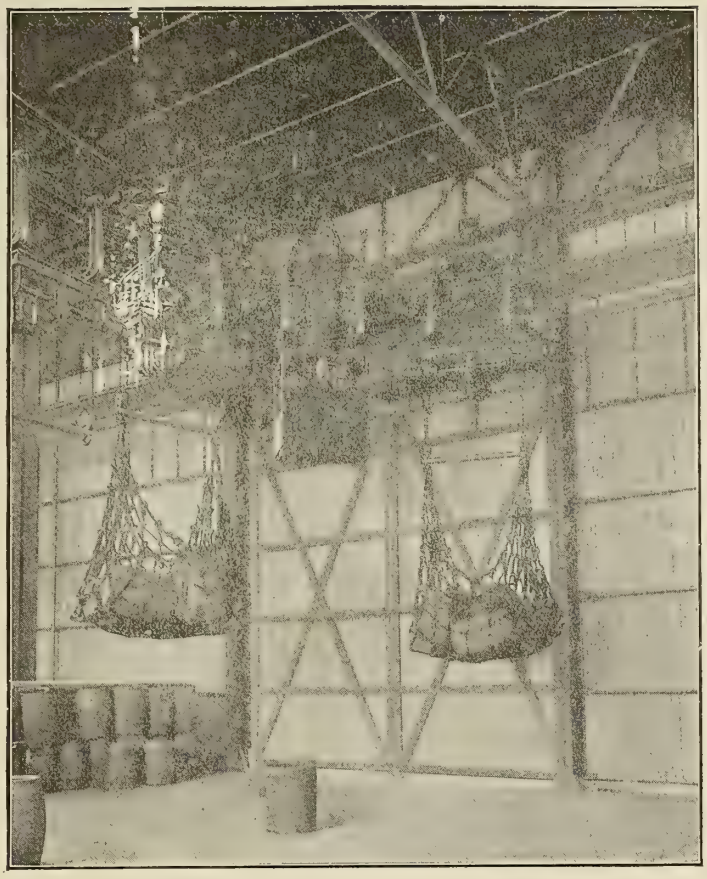
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Keller Pneumatic Tool Company, Grand Haven, Mich.
National Tube Company, Frick Building, Pittsburgh, Pa.
Oldham, George & Son Co., Frankford, Philadelphia, Pa.

AIRCRAFT APPARATUS
Gwilliam Company, The, 253 West 18th Street, New York
Sperry Gyroscope Company, Brooklyn, New York

AIR DRILLS
(See Pneumatic Tools)

AIR HAMMERS
(See Pneumatic Tools)

AIR HOISTS
Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.
Dake Engine Company, Grand Haven, Mich.
Great Lakes Engineering Works, Detroit, Mich.
Independent Pneumatic Tool Company, 600 West Jackson Blvd., Chicago, Ill.
Ingersoll-Rand Company 11 Broadway, New York

AIR HOSE
Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.
Goodyear Tire & Rubber Co., Akron, Ohio
Independent Pneumatic Tool Company, 600 West Jackson Blvd., Chicago, Ill.
Ingersoll-Rand Company 11 Broadway, New York
Keller Pneumatic Tool Company, Grand Haven, Mich.
Oldham & Son Co., Geo., Frandford, Philadelphia, Pa.
United States Rubber Company, 1790 Broadway, New York
Williams, Wm. E., 62 Front Street, New York

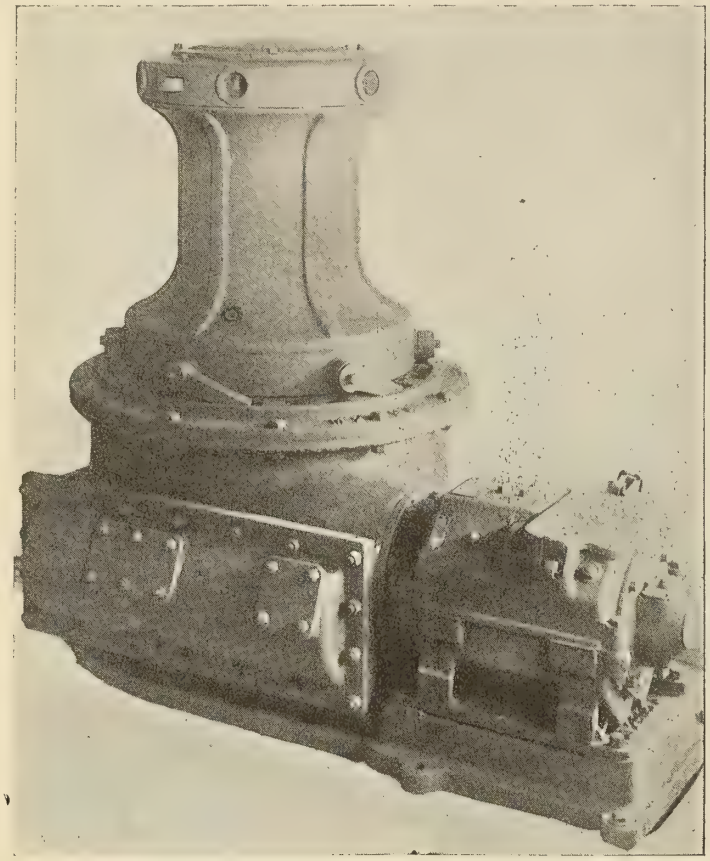
AIR HOSE FITTINGS
Cleveland Pneumatic Tool Company, Cleveland, Ohio
Keller Pneumatic Tool Company, Grand Haven, Mich.

AIR MOTORS
Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.
Cleveland Pneumatic Tool Company, Cleveland, Ohio
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Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill.
Ingersoll-Rand Company 11 Broadway, New York
Keller Pneumatic Tool Company, Grand Haven, Mich.

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(See Pneumatic Planers)

AIR PORTS
Cory & Son, Charles, 290 Hudson Street, New York
Dake Engine Company, Grand Haven, Mich.
McNab Company, The, Bridgeport, Conn.
Rostand Manufacturing Company, Milford, Conn.
Sands, A. B., & Son Co., 22 Vesey Street, New York
Stevens-Aylsworth Co., Inc., 253 Broadway, New York
Tiebout, W. & J., 118 Chambers Street, New York
Williams, Wm. E., 62 Front Street, New York

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Cameron Steam Pump Works, A. S., 11 Broadway, New York
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Dean Bros. Steam Pump Works, Indianapolis, Ind.



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The worm, worm-shaft, and bearings are all contained in a single unit bolted to the side of the main casting, and can be easily removed without disturbing the rest of the machine.

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Schutte & Koerting Company, 12th & Thompson Streets, Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wheeler Manufacturing Co., C. H., Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York
Worthington Pump & Machinery Corporation, 115 Broadway, New York

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Powell Company, The William, Cincinnati, Ohio

AIR WASHERS
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Standard Motor Construction Company, 120 Pine Street, Jersey City, N. J.

ALUMINUM CASTINGS
(See Castings, Aluminum)

AMMETERS
(See Electrical Instruments)

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Williams, Wm. E., 62 Front Street, New York
York Manufacturing Company, York, Pa.

AMMONIA PACKING
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France Packing Company, Tacony, Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York

AMMONIA VALVES
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York Manufacturing Company, York, Pa.

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American Engineering Company, Philadelphia, Pa.
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Baldt Anchor Company, Chester, Pa.
Malleable Iron Fittings Company, Brandford, Conn.
McNab Company, The, Bridgeport, Conn.
Penn Seaboard Steel Corporation, Franklin Bank Bldg, Philadelphia, Pa.
Thacher Propeller & Foundry Corporation, Albany, N. Y.
Topping Brothers, 122 Chambers Street, New York
Upson-Walton Company, 280 Broadway, New York
Williams, Wm. E., 62 Front Street, New York

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American Engineering Company, Philadelphia, Pa.

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(See Oil Furnaces)

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Lunkenheimer Company, The, Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio
Richardson-Phenix Company, 120 Reservoir Avenue, Milwaukee, Wis.
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Watson-Stillman Company, 50 Church Street, New York
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

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Edwards & Company, Inc., 140th & Exterior Streets, New York

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(See Anti-Rust Coatings)

ANTI-RUST COATINGS
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duPont deNemours & Co., E. I., Wilmington, Del.
Ferdinand, L. W., & Co., 152 Kneeland Street, Boston, Mass.
International Compositions Co., 18 Broadway, New York
Toch Brothers, 320 Fifth Avenue, New York

ANVILS
Topping Brothers, 122 Chambers Street, New York
Williams, Wm. E., 62 Front Street, New York

ARCHITECTURAL IRON
Page Steel & Wire Company, 30 Church Street, New York

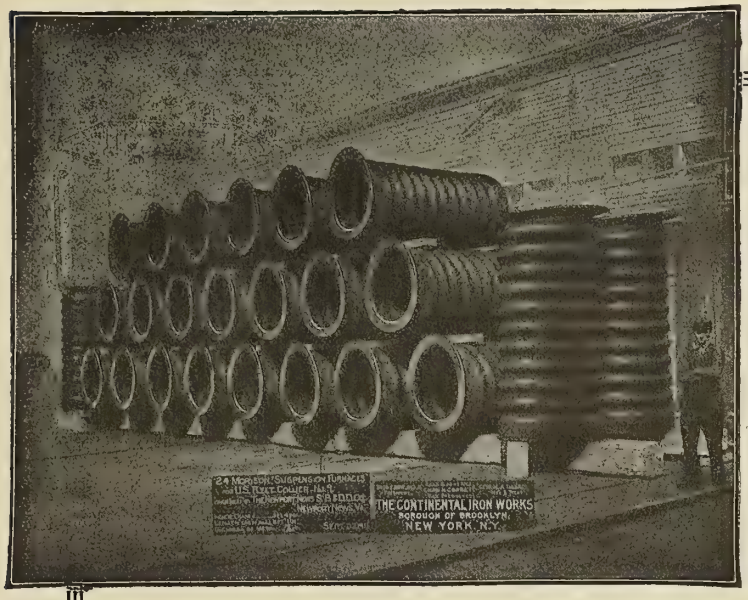
ARBORS
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ARC WELDING
(See Welding, Electrical)

ASBESTOS PACKING
(See Packing, Asbestos)

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Row & Davis, Engineers, Inc., 90 West Street, New York
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ASPHALT PAINT
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Texas Company, The, 17 Battery Place, New York
Williams, Wm. E., 62 Front Street, New York

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(See Fire Alarms)

AUTOMATIC INJECTORS
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Williams, Wm. E., 62 Front Street, New York

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(See Towing Machines)

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Williams, Wm. E., 62 Front Street, New York

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Gwilliam Company, The, 253 West 58th Street, New York
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Buffalo Steam Pump Company, Buffalo, N. Y.
Cameron Steam Pump Works, A. S., 11 Broadway, New York
Dean Brothers Steam Pump Works, Indianapolis, Ind.
Fairbanks, Morse & Company, 900 South Wabash Avenue, Chicago, Ill.
Kinney Manufacturing Company, Boston, Mass.
Morris Machine Works, Baldwinsville, N. Y.
Steam Motors Company, Inc., Springfield, Mass.
Terry Steam Turbine Company, Hartford, Conn.
Worthington Pump & Machinery Corporation, 115 Broadway, New York

BALSA WOOD
American Balsa Company, 50 East 42nd Street, New York

BARGES
Baltimore Dry Docks & Shipbldg. Company, Baltimore, Md.
Dravo-Doyle Company, Pittsburgh, Pa.
Valk & Murdock Company, Charleston, S. C.

BARGE DERRICKS
Lidgerwood Manufacturing Company, 96 Liberty Street, New York

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Taylor Instrument Companies, Rochester, N. Y.
Williams, Wm. E., 62 Front Street, New York

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Harvey Company, Arthur C., 374 Congress Street, Boston, Mass.
Williams, Wm. E., 62 Front Street, New York

BATH PUMPS
Mott Iron Works, J. L., Trenton, N. J.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Williams, Wm. E., 62 Front Street, New York

BATH TUBS
Crane Company, 836 So. Michigan Avenue, Chicago, Ill.
Mott Iron Works, J. L., Trenton, N. J.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Williams, Wm. E., 62 Front Street, New York

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Harvey, Arthur C., Company, 374 Congress Street, Boston, Mass.

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(See Ball Bearings and Roller Bearings)

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Edwards & Company, Inc., 140th & Exterior Streets, New York
Klaxon Company, Metropolitan Tower, New York
Western Electric Company, 151 Fifth Avenue, New York

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(Also see Rubber Belting)
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Graton & Knight Manufacturing Co., Worcester, Mass.
United States Rubber Company, 1790 Broadway, New York
Williams, Wm. E., 62 Front Street, New York

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Texas Company, The, 17 Battery Place, New York
Williams, Wm. E., 62 Front Street, New York

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Pratt & Whitney Company, Inc., Hartford, Conn.
Starrett, L. S., Company, Athol, Mass.
Standard Tool Company, Cleveland, Ohio
Whitman & Barnes Mfg. Company, Akron, Ohio
Williams & Co., J. H., 63 Richards Street, Brooklyn, N. Y.
Williams, Wm. E., 62 Front Street, New York

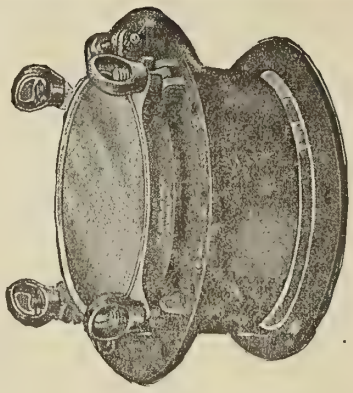
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Watson-Stillman Company, 50 Church Street, New York

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(See Rolls)

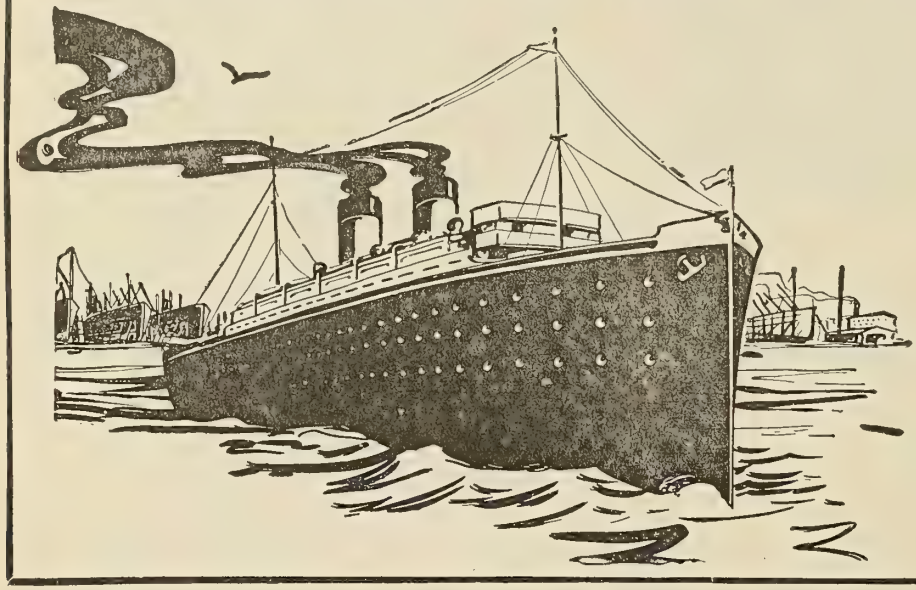
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Cameron Steam Pump Works, A. S., 11 Broadway, New York
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McNab Company, The, Bridgeport, Conn.
Williams, Wm. E., 62 Front Street, New York

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McNab Company, The, Bridgeport, Conn.
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Thacher Propeller & Foundry Corporation, Albany, N. Y.
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Diamond Power Specialty Company, Detroit, Mich.
General Electric Company, Schenectady, N. Y.
Howden & Company, James, Wellsville, N. Y.
Kearfott Engineering Company, 95 Liberty Street, New York
Ohio Blower Company, Cleveland, Ohio
Reid & Company, John, 30 Church Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
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Sturtevant Company, B. F., Hyde Park, Boston, Mass.
Terry Steam Turbine Company, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Lunkenheimer Company, The, Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio
Pratt & Cady Company, Inc., Hartford, Conn.
Richardson-Phenix Company, 120 Reservoir Avenue, Milwaukee, Wis.
William Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

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Stevens-Aylsworth Co., Inc., 253 Broadway, New York
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BOAT DAVITS
(See Davits)

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Williams, Wm. E., 62 Front Street, New York

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Ames Shipbuilding & Dry Dock Company, Hoge Building, Seattle, Wash.
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Badenhausen Company, 1425 Chestnut Street, Philadelphia, Pa.
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Hyde Windlass Company, Bath, Maine
Kearfott Engineering Company, 95 Liberty Street, New York
Kingsford Foundry & Machine Company, Oswego, N. Y.
Manitowoc Shipbuilding Company, Manitowoc, Wis.
Morse Dry Dock & Repair Co., Brooklyn, N. Y.
New York Engineering Company, 2 Rector Street, New York
Pacific Marine Iron Works, Portland, Ore.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Company, Charleston, S. C.
Vulcan Iron Works, Inc., Foot of Hudson Street, Jersey City, N. J.
Ward, Charles, Engineering Works, Charleston, W. Va.

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Morris Machine Works, Baldwinsville, N. Y.
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
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Continental Iron Works, The West & Calyer Streets, Brooklyn, N. Y.

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BOILER RIVETS
(See Rivets)

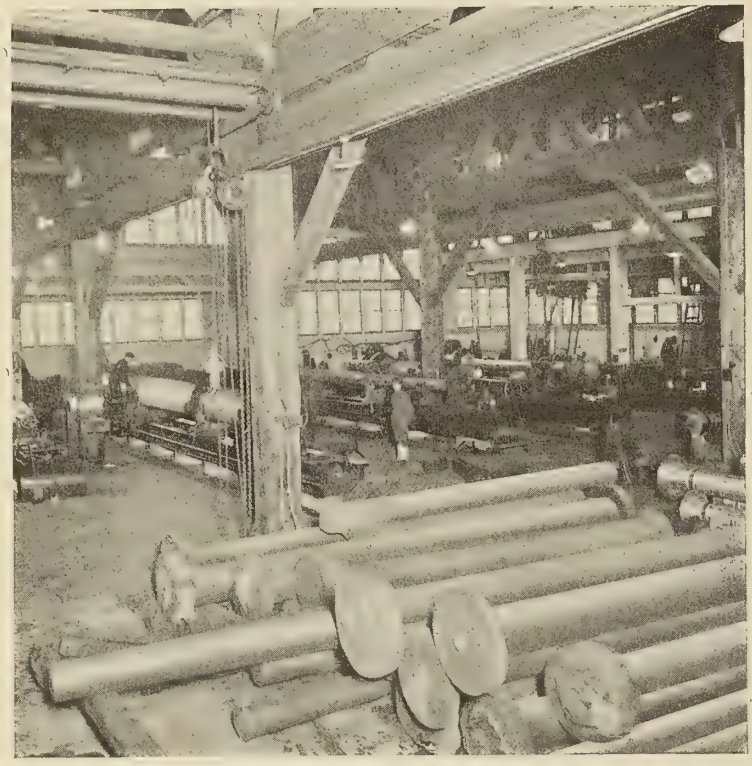
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Ashton Valve Company, 171 First Street, Cambridge, Mass.
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Valve Stems
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Mason Regulator Company, Dorchester Centre, Boston, Mass.
National Tube Company, Frick Building, Pittsburgh, Pa.
Powell, Wm., The, Cincinnati, Ohio
Reid & Company, John, 30 Church Street, New York
Richardson-Phenix Company, 120 Reservoir Avenue, Milwaukee, Wis.
Row & Davis, Engineers, Inc., 90 West Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Union Water Meter Company, Worcester, Mass.
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

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(See Staybolts)

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Williams, Wm. E., 62 Front Street, New York

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Kearfott Engineering Company, 95 Liberty Street, New York
National Tube Company, Frick Building, Pittsburgh, Pa.
Parkesburg Iron Company, Parkesburg, Pa.
Williams, Wm. E., 62 Front Street, New York

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Russell, Burdsall & Ward Bolt & Nut Co., Rochester, N. Y.
Topping Brothers, 122 Chambers Street, New York
Williams, Wm. E., 62 Front Street, New York

BOOMS—TUBULAR STEEL
National Tube Company, Frick Building, Pittsburgh, Pa.

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(See Cylinder Boring Bars)

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Niles-Bement-Pond Company, 111 Broadway, New York

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Cleveland Pneumatic Tool Company, Cleveland, Ohio
Independent Pneumatic Tool Company, 600 West Jackson Blvd., Chicago, Ill.
Ingersoll-Rand Company, 11 Broadway, New York

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Niles-Bement-Pond Company, 111 Broadway, New York

BOTTOM PAINTS FOR SHIPS
International Compositions Company, 18 Broadway, New York
Toch Brothers, 320 Fifth Avenue, New York

BRASS AND COPPER
Sands, A. B., & Sons Co., 22 Vesey Street, New York
Williams, Wm. E., 62 Front Street, New York

BRASS CASTINGS
(See Castings, Brass)

BRASS FITTINGS
American Steam Gauge & Valve Mfg. Co., Camden Street, Boston, Mass.
Ashton, Valve Company, 171 First Street, Cambridge, Mass.
Bridgeport Brass Co., Bridgeport, Conn.
Crane Company, The, 836 So. Michigan Avenue, Chicago, Ill.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Company, The, Cincinnati, Ohio
Mason Regulator Company, Dorchester Centre, Boston, Mass.
Powell Company, The William, Cincinnati, Ohio
Richardson-Phenix Company, 120 Reservoir Avenue, Milwaukee, Wis.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Tiebout, W. & J., 118 Chambers Street, New York
Williams Valve Mfg. Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

BRAZING MATERIALS
Smooth-On Manufacturing Company, 570 Communipaw Avenue, Jersey City, N. J.

BRIDGE CONTROL
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

BRIDGE WALLS
(See Furnace Bridge Walls)

BROKERS
(See Ship Brokers)

BRONZE
American Manganese Bronze Company, Holmesburg, Philadelphia, Pa.
Columbian Bronze Corporation, 50 Church Street, New York
Cramp & Son, William, Ship & Engine Bldg. Co., Richmond & Norris Streets, Philadelphia, Pa.
Crane Company, 836 So. Michigan Avenue, Chicago, Ill.
Lunkenheimer Company, Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

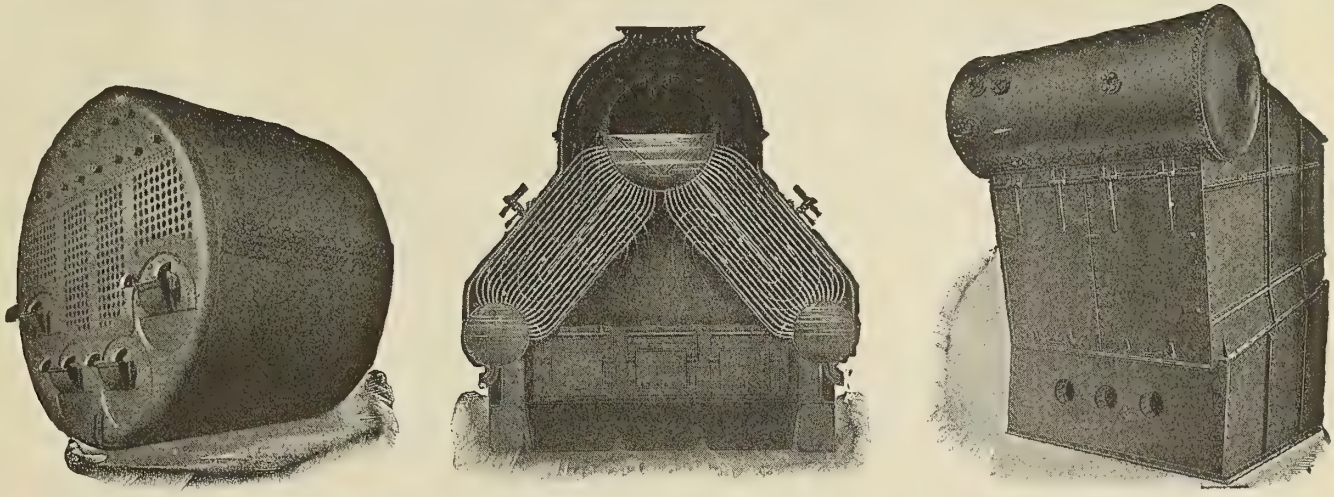
BUILDERS
Monks & Johnson, 99 Chauncy Street, Boston, Mass.

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Bernstein Manufacturing Co., 3d & Allegheny Avenues, Philadelphia, Pa.
Foster Bros. Manufacturing Co., Utica, N. Y.
Southern-Rome Company, 617a West Pratt Street, Baltimore, Md.

BUOYS
Galbraith, C. C., & Son, 47 West Street, New York
Williams, Wm. E., 62 Front Street, New York

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National Tube Company, Frick Building, Pittsburgh, Pa.
Williams, Wm. E., 62 Front Street, New York

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Griscom-Russell Company, 90 West Street, New York
Lunkenheimer Company, The Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.

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CABLEWAYS
(See Marine Cableways)

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CANVAS
Upson-Walton Company, 280 Broadway, New York
Williams, Wm. E., 62 Front Street, New York

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American Engineering Company, Philadelphia, Pa.
American Shipbuilding Company, Cleveland, Ohio
Dake Engine Company, Grand Haven, Mich.
Flory, S., Manufacturing Company, Bangor, Pa.
Hyde Windlass Company, Bath, Maine
Mundy Hoisting Engine Company, J. S., Newark, N. J.
National Hoisting Engine Company, Harrison, N. J.
Thacher Propeller & Foundry Corporation, Albany, N. Y.
Williams, Wm. E., 62 Front Street, New York

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York Manufacturing Company, York, Pa.

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Frick Company, Waynesboro, Pa.
Kroeschell Bros. Ice Machine Co., 472 West Erie Street, Chicago, Ill.
York Manufacturing Company, York, Pa.

CAR DUMPERS
McMyler Interstate Company, Cleveland, Ohio
Brown Hoisting Machinery Company, Cleveland, Ohio

CARGO HOISTS
(See Hoisting Engines)

CARGO LIGHTS
Benjamin Electric Manufacturing Company, Chicago, Ill.
General Electric Company, Schenectady, N. Y.
Western Electric Company, 151 Fifth Avenue, New York
Williams, Wm. E., 62 Front Street, New York

CARGO WINCHES
(See Winches)

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Powell Company, The William, Cincinnati, Ohio
Sands, A. B., & Son Company, 22 Vesey Street, New York
Griscom-Russell Company, 90 West Street, New York
Hyde Windlass Company, Bath, Maine
Hooven, Owens, Rentschler Company, Hamilton, Ohio
Stevens-Aylsworth Co., Inc., 254 Broadway, New York

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Benjamin Electric Manufacturing Company, Chicago, Ill.
Bridgeport Brass Co., Bridgeport, Conn.
Cory, Chas., & Son, Inc., 290 Hudson Street, New York
Cramp & Sons, Wm., Ship & Engine Bldg. Co., Richmond & Norris Streets, Philadelphia, Pa.
Crane Company, 836 So. Michigan Avenue, Chicago, Ill.
Fletcher, W. & A., Company, Hoboken, N. J.
Griscom-Russell Company, 90 West Street, New York
Hyde Windlass Company, Bath, Maine
Lunkenheimer Company, The, Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio
Rostand Manufacturing Company, Milford, Conn.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Tiebout, W. & J., 118 Chambers Street, New York
Valk & Murdoch Company, Charleston, S. C.
William Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

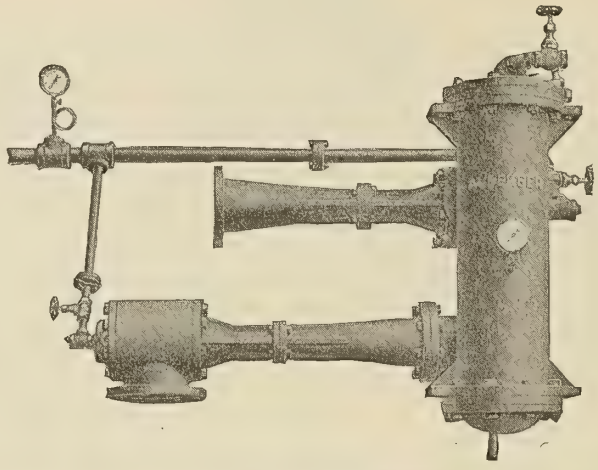
CASTINGS—BRONZE
American Manganese Bronze Company, Holmesburgh, Philadelphia, Pa.
American Steel Foundries, McCormick Building, Chicago, Ill.
Benjamin Electric Manufacturing Company, Chicago, Ill.
Columbian Bronze Corporation, 50 Church Street, New York
Cory, Chas., & Son, Inc., 290 Hudson Street, New York
Cramp & Sons, Wm., Ship & Engine Bldg. Co., Richmond & Norris Streets, Philadelphia, Pa.
Crane Company, The, 836 So. Michigan Avenue, Chicago, Ill.
Fletcher Co., W. & A., Hoboken, N. J.

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Powell Company, The William, Cincinnati, Ohio
Rostand Manufacturing Company, Milford, Conn.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Stevens-Aylsworth Co., Inc., 253 Broadway, New York
Tiebout, W. & J., 118 Chambers Street, New York
Valk & Murdoch Company, Charleston, S. C.
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

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Hooven, Owens, Rentschler Co., Hamilton, Ohio
Norwalk Iron Works, South Norwalk, Conn.
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Thacher Propeller & Foundry Corporation, Albany, N. Y.
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Central Foundry Company, 90 West Street, New York
Cramp & Son, Wm., Ship & Engine Building Co., Richmond & Norris Streets, Philadelphia, Pa.
Crane Company, The, 836 South Michigan Avenue, Chicago, Ill.
Fletcher Company, W. & A., Hoboken, N. J.
General Steel Company, Public Service Building, Milwaukee, Wis.
Griscom-Russell Company, 90 West Street, New York
Hardie-Tynes Manufacturing Company, Birmingham, Ala.
Hyde Windlass Company, Bath, Maine
Hooven, Owens, Rentschler Company, Hamilton, Ohio
Lukenheimer Company, The, Cincinnati, Ohio
Penn Seaboard Steel Corporation, Franklin Bank Building, Philadelphia, Pa.
Sands, A. B., & Son Company, 22 Vesey Street, New York
Stevens-Aylsworth Co., Inc., 253 Broadway, New York

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Cameron Steam Pump Works, A. S., 11 Broadway, New York
Fairbanks-Morse & Company, 900 South Wabash Avenue, Chicago, Ill.
Morris Machine Works, Baldwinsville, N. Y.
Steam Motors Company, Springfield, Mass.
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.
Wheeler Manufacturing Company, C. H., Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York
Worthington Pump & Machinery Corporation, 115 Broadway, New York

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Harvey Company, Arthur C., 374 Congress Street, Boston, Mass.
Topping Brothers, 122 Chambers Street, New York
Upson-Walton Company, 280 Broadway, New York

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Niles-Bement-Pond Company, 111 Broadway, New York
Topping Brothers, 122 Chambers Street, New York
Williams, Wm. E., 62 Front Street, New York
Wyatt, Thos. Mfg. Company, Boston, Mass.
Yale & Towne Manufacturing Company, 9 East 40th Street, New York

CHAIN PIPE
Central Foundry Company, 90 West Street, New York

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Williams, Wm. E., 62 Front Street, New York
Wyatt, Thos. Manufacturing Company, Boston, Mass.

CHAIN PIPE WRENCHES
American Engineering Company, Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York

CHAIN STOPPERS
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Williams, Wm. E., 62 Front Street, New York

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Lunkenheimer Company, The, Cincinnati, Ohio
Powell Company, The William, Cincinnati, Ohio

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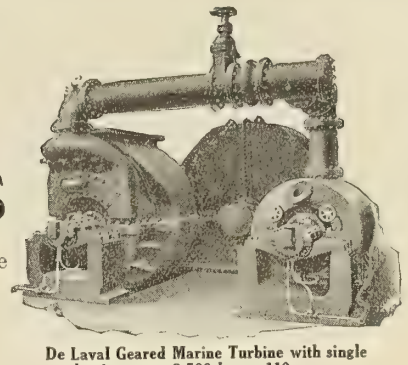
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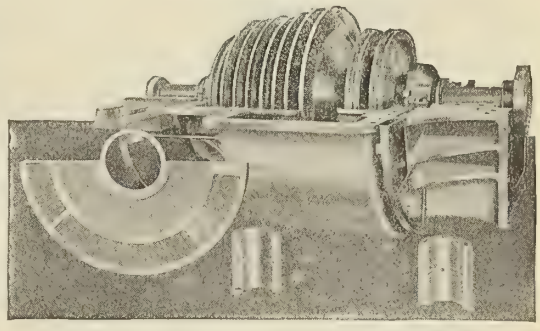
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Lunkenheimer Company, The, Cincinnati, Ohio
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Powell Company, The William, Cincinnati, Ohio
Pratt & Cady Company, Inc., Hartford, Conn.
Richardson-Phenix Company, The, 120 Reservoir Avenue, Milwaukee, Wis.
Sands & Son Company, A. B., 22 Vesey Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Watson-Stillman Company, 50 Church Street, New York
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

CHIPPING HAMMERS
(See Pneumatic Tools)

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Keller Pneumatic Tool Company, Grand Haven, Mich.
Williams, Wm. E., 62 Front Street, New York

CHISEL BLANKS
Cleveland Steel Tool Company, 660 E. 82d Street, Cleveland, Ohio
Cleveland Punch & Shear Works Company, Cleveland, Ohio
Ingersoll-Rand Company, 11 Broadway, New York
Keller Pneumatic Tool Company, Grand Haven, Mich.

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McNab Company, The, Bridgeport, Conn.
Williams, Wm. E., 62 Front Street, New York

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Union Water Meter Company, The, Worcester, Mass
Williams, Wm. E., 62 Front Street, New York

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American Engineering Company, Philadelphia, Pa.
Central Foundry Company, 90 West Street, New York
Great Lakes Engineering Works, Detroit, Mich.
Penn Seaboard Steel Corp., Franklin Bank Bldg., Philadelphia, Pa.
Thacher Propeller & Foundry Corporation, Albany, N. Y.
Williams, Wm. E., 62 Front Street, New York

CHUCKS
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Ingersoll-Rand Company, 11 Broadway, New York
Keller Pneumatic Tool Company, Grand Haven, Mich.
Morse Twist Drill & Machine Company, New Bedford, Mass.
Rich Tool Company, Railway Exchange, Chicago, Ill.
Rostand Manufacturing Company, Milford, Conn.
Williams, Wm. E., 62 Front Street, New York

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Buffalo Steam Pump Company, Buffalo, N. Y.
Cameron Steam Pump Works, A. S., 11 Broadway, New York
Davidson Company, M. T., 154 Nassau Street, New York
Dean Bros. Steam Pump Works, Indianapolis, Ind.
De Laval Steam Turbine Company, 400 Nottingham Way, Trenton, N. J.
Epping-Carpenter Pump Company, Pittsburgh, Pa.
Fairbanks, Morse & Company, 900 South Wabash Avenue, Chicago, Ill.
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Kingsford Foundry & Machine Company, Oswego, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Steam Motors Company, Springfield, Mass.
Terry Steam Turbine Company, Hartford, Conn.
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Williams, Wm. E., 62 Front Street, New York

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Hand, John E. & Sons Company, Haddonfield, N. J.
McNab Company, The, Bridgeport, Conn.
Williams, Wm. E., 62 Front Street, New York

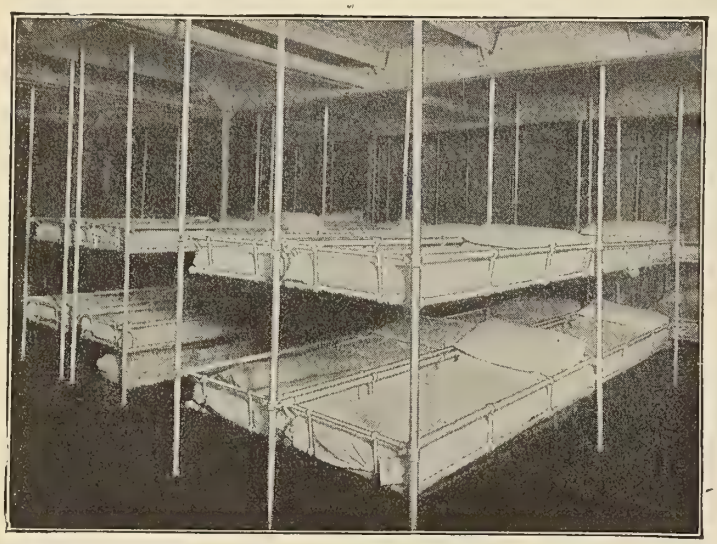
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(See Anti-Rust Coatings)

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(See Gauge Cocks)

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National Tube Company, Frick Building, Pittsburgh, Pa.
Powell Company, The William, Cincinnati, Ohio
Williams Valve Company, D. T., Cincinnati
Williams, Wm. E., 62 Front Street, New York

COMPASSES
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Sperry Gyroscope Company, Brooklyn, N. Y.
McNab Company, The, Bridgeport, Conn.
Williams, Wm. E., 62 Front Street, New York

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(See Automatic Compensators)

COMPOSITIONS
(See Ship's Compositions)

COMPRESSION RIVETERS
(See Power Riveters)

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American Engineering Company, Philadelphia, Pa.
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Buffalo Steam Pump Company, Buffalo, N. Y.
Consolidated Shipbuilding Corporation, Morris Heights, New York
Davidson Company, M. T., 154 Nassau St., New York
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Fletcher Company, W. & A., Hoboken, N. J.
Great Lakes Engineering Works, Detroit, Mich.
Griscom-Russell Company, 90 West Street, New York
Kearfott Engineering Company, 95 Liberty Street, New York
Ross Heater & Manufacturing Company, Buffalo, N. Y.
Row & Davis Engineers, Inc., 90 West Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Traylor Engineering & Mfg. Co., Allentown, Pa.
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.
Wheeler Condenser & Engineering Company, Carteret, N. J.
Wheeler Manufacturing Co., C. H., Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York
Worthington Pump & Machinery Corporation, 115 Broadway, New York

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Bridgeport Brass Co., Bridgeport, Conn.
Kearfott Engineering Company, 95 Liberty Street, New York
Wheeler Condenser & Engineering Company, Carteret, N. J.
Williams, Wm. E., 62 Front Street, New York

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Williams & Company, J. H., 63 Richards Street, Brooklyn, N. Y.

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(See Engineers, Consulting)

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Dravo Contracting Company, Pittsburgh, Pa.
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Lidgerwood Manufacturing Company, 96 Liberty Street, New York
McMyler Interstate Company, Cleveland, Ohio
Maine Electric Co., Portland, Me.
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Mundy, J. S., Hoisting Engine Company, Newark, N. J.
National Hoisting Engine Company, Harrison, N. J.

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(See Conveying Machinery)

CO^2 ICE MACHINES
(See Carbon Dioxide Machines)

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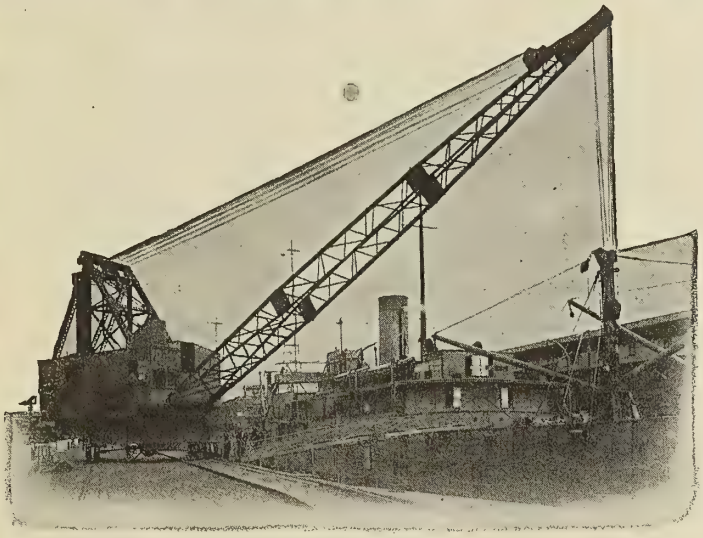
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Whitman & Barnes Mfg. Company, Akron, Ohio

COUPLINGS
(See Hose Couplings)

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(See Non-conducting Coverings)

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Chambersburg Engineering Company, Chambersburg, Pa.
Dravo-Doyle Company, Pittsburgh, Pa.
Lakeside Bridge & Steel Company, 139 Villard Ave., North Milwaukee, Wis.
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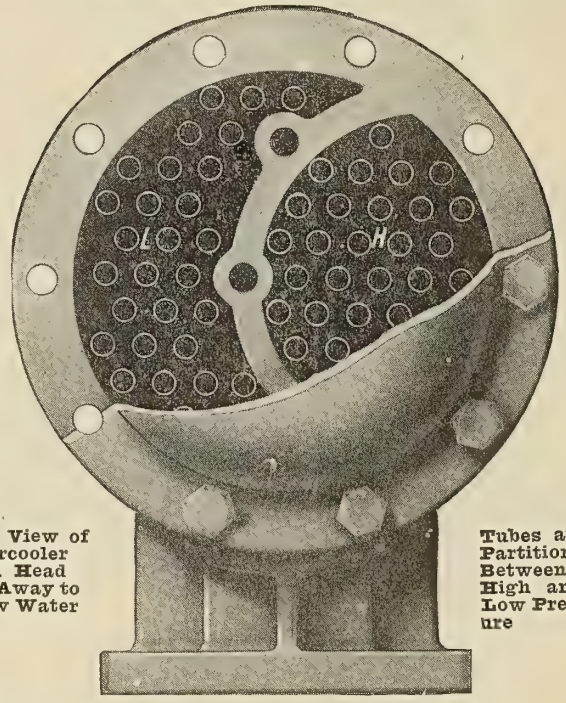
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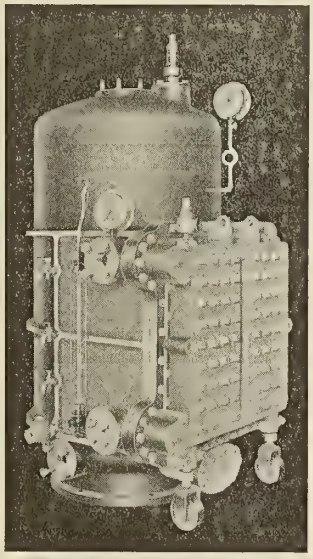
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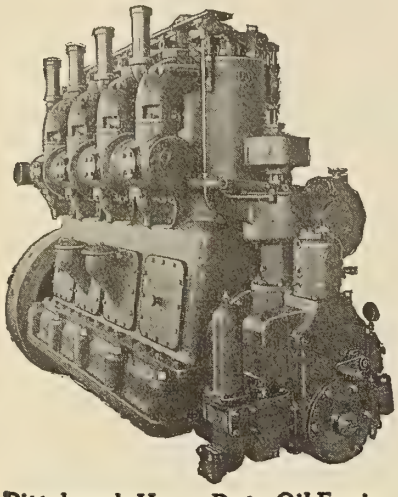
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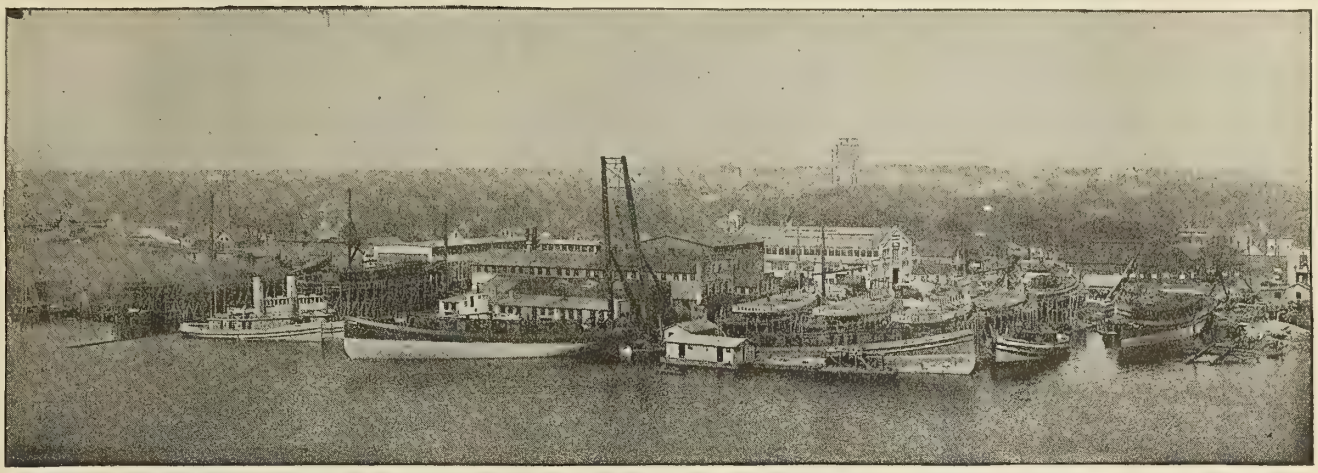
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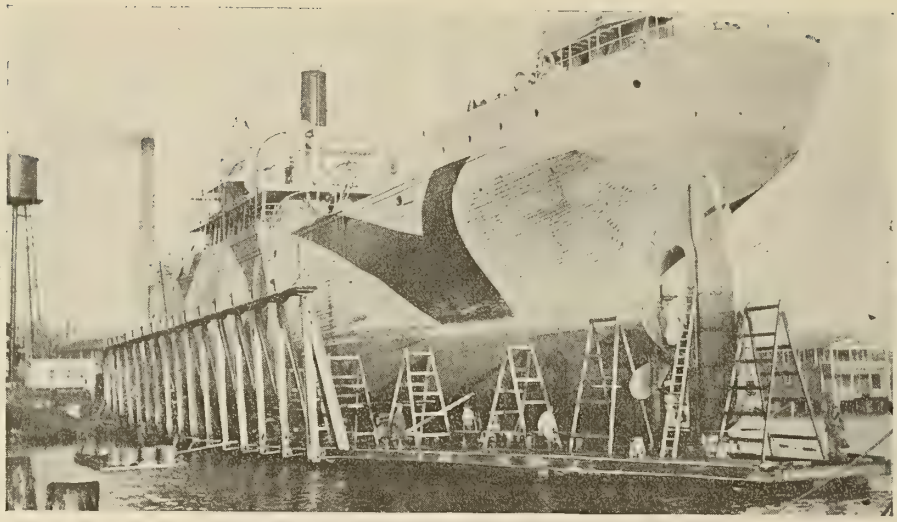
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FAIRLEADERS
Thacher Propeller & Foundry Corporation, Albany, N. Y.

FANS
(See Blowers)

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Griscom-Russell Company, 90 West Street, New York
Kearfott Engineering Company, 95 Liberty Street, New York
Ross Heater & Manufacturing Company, Buffalo, N. Y.
Row & Davis, Engineers, Inc., 90 West Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York

FEED WATER REGULATORS
Alberger Pump & Condenser Company, 140 Cedar Street, New York
Jerguson Gage & Valve Company, Winter Hill, Somerville, Mass.
Kearfott Engineering Company, 95 Liberty Street, New York

FENCES
(See Wire Fences)

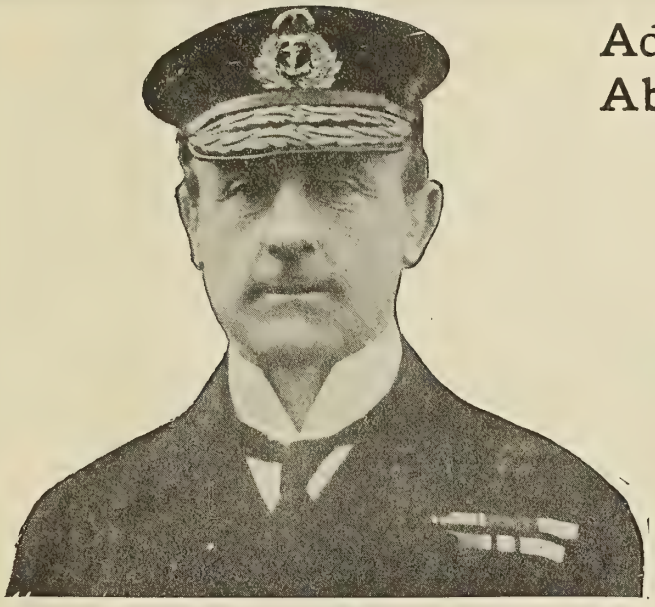
FERRULES—CONDENSER TUBE
(See Condenser Tube Ferrules)

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Nicholson File Company, Providence, R. I.
Whitman & Barnes Manufacturing Company, Akron, Ohio
Williams, Wm. E., 62 Front Street, New York

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Row & Davis, Engineers, Inc., 90 West Street, New York
Schutte & Koerting Company, 1158 Thompson Street, Philadelphia, Pa.
Williams, Wm. E., 62 Front Street, New York

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Klaxon Company, Metropolitan Tower, New York

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Williams, Wm. E., 62 Front Street, New York

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(See Hose)

FIREPROOF LUMBER
(See Lumber, Fireproof)

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Dean Bros. Steam Pump Works, Indianapolis, Ind.
Epping-Carpenter Pump Company, Pittsburgh, Pa.
Morris Machine Works, Baldwinsville, N. Y.
Worthington Pump & Machinery Corporation, 115 Broadway, New York

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Crane Company, The, 836 So. Michigan Avenue, Chicago, Ill.
Dart, E. M., Mfg. Company, Providence, R. I.
Lunkenheimer Company, The, Cincinnati, Ohio
National Tube Company, Frick Building, Pittsburgh, Pa.
Penn Seaboard Steel Corp., Franklin Bank Building, Philadelphia, Pa.
Williams Valve Company, D. T., Cincinnati, Ohio
Williams, Wm. E., 62 Front Street, New York

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Niles-Bement-Pond Company, 111 Broadway, New York
Watson-Stillman Company, 50 Church Street, New York

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McMyler-Interstate Company, Bedford, Ohio
Maine Electric Co., Portland, Maine
Manitowoc Shipbuilding Company, Manitowoc, Wis.

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Lunkenheimer Company, The, Cincinnati, Ohio
Mason Regulator Company, Dorchester Centre, Boston, Mass.

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FLOOR PLATES
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Harvey, Arthur C., Company, 374 Congress Street, Boston, Mass.

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FLUE CUTTERS
(See Boiler Flue Cutters)

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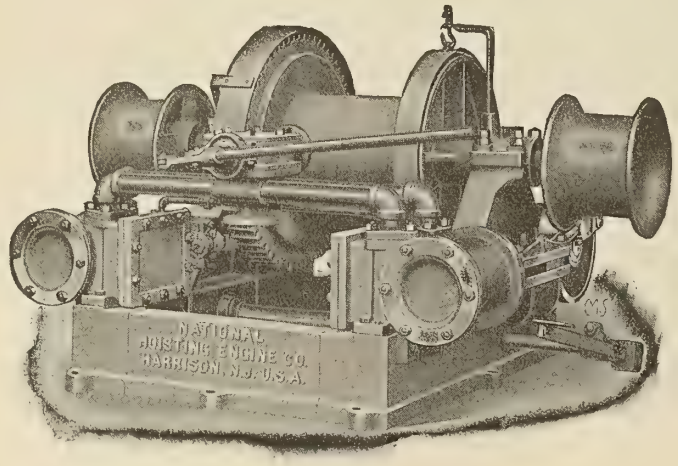
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Manning, Maxwell & Moore, Inc., 119 West 40th Street, New York
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Wayne Oil Tank & Pump Company, 589 Canal Street, Fort Wayne, Ind.

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Williams, Wm. E., 62 Front Street, New York

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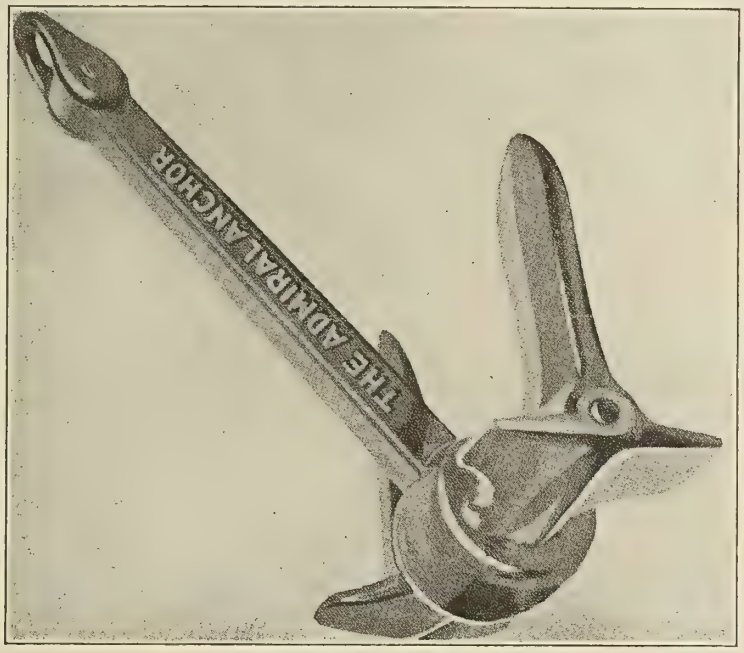
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Williams, Wm. E., 62 Front Street, New York

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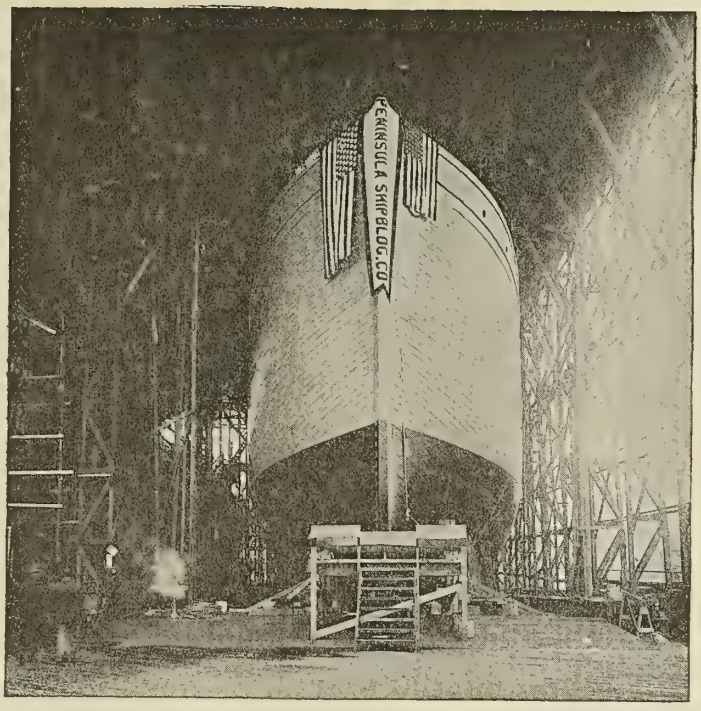
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Hyde Windlass Company, Bath, Maine
Lidgerwood Manufacturing Company, 96 Liberty Street, New York
McNab Company, The, Bridgeport, Conn.
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(See Chain Hoists)

HOISTS, ELECTRIC
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Keller Pneumatic Tool Company, Grand Haven, Mich.
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NcNab Company, The, Bridgeport, Conn.

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Taylor Instrument Companies, Rochester, N. Y.

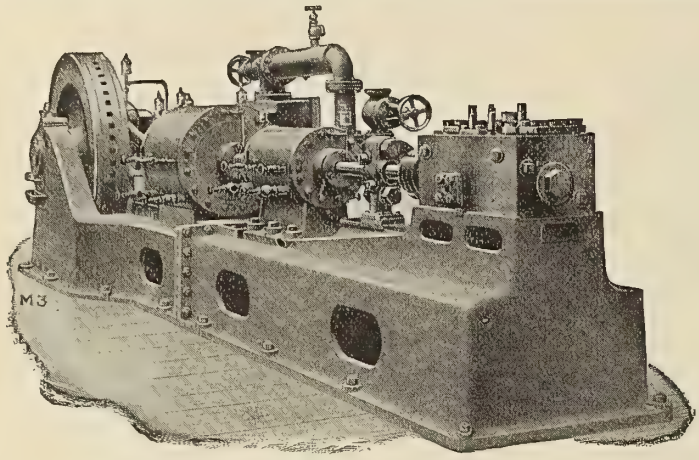
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McNab Company, The, Bridgeport, Conn.

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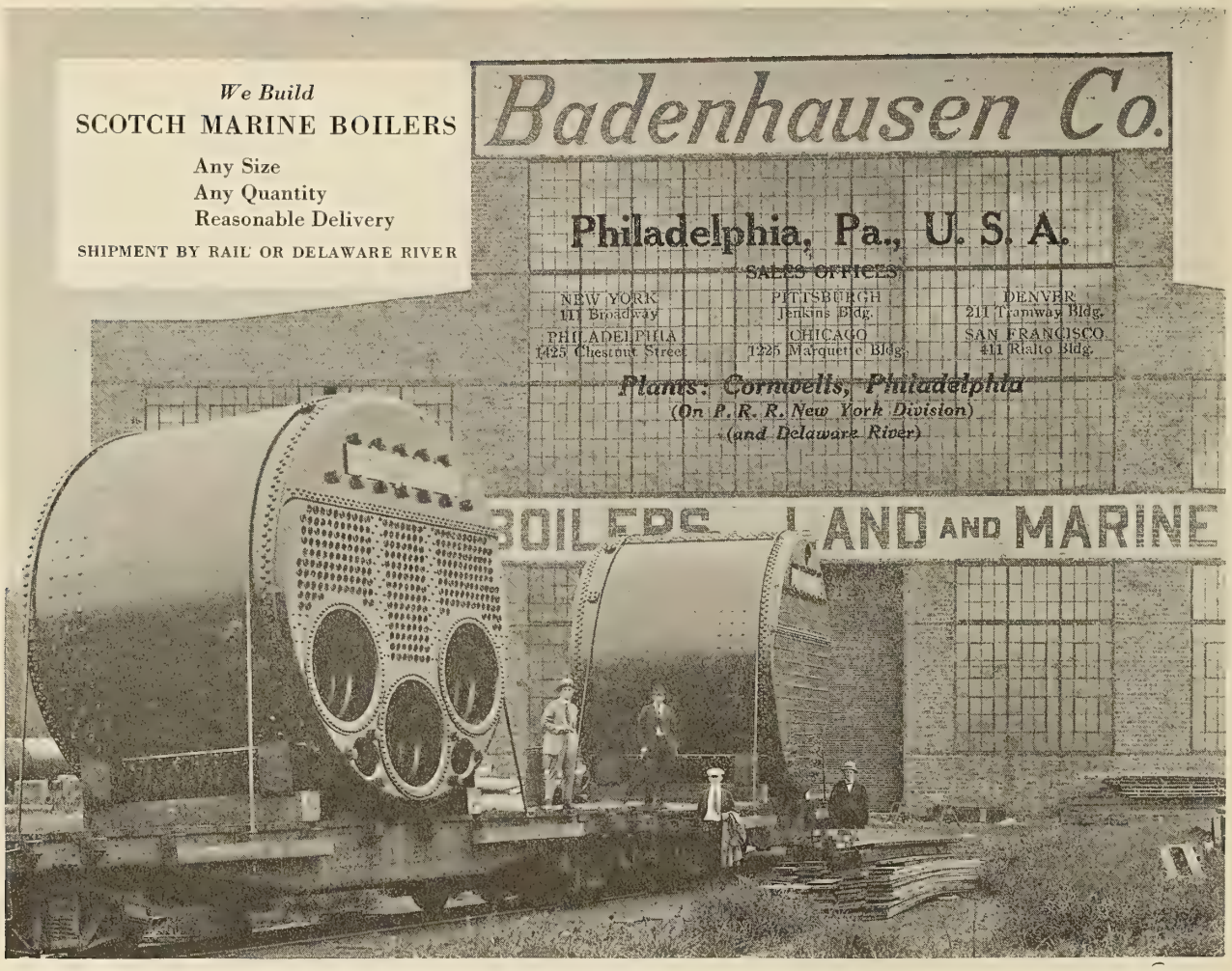
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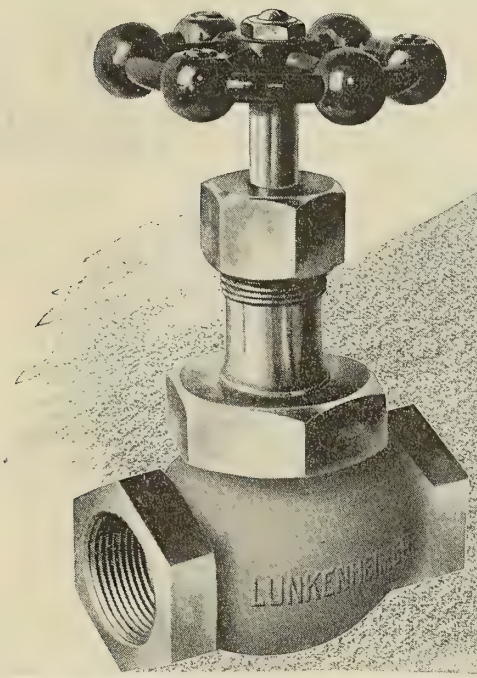
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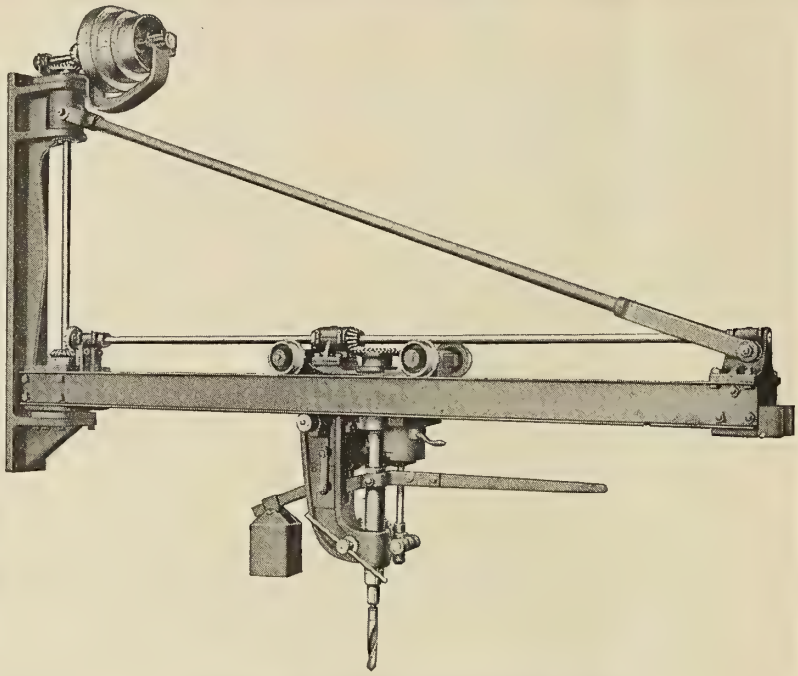
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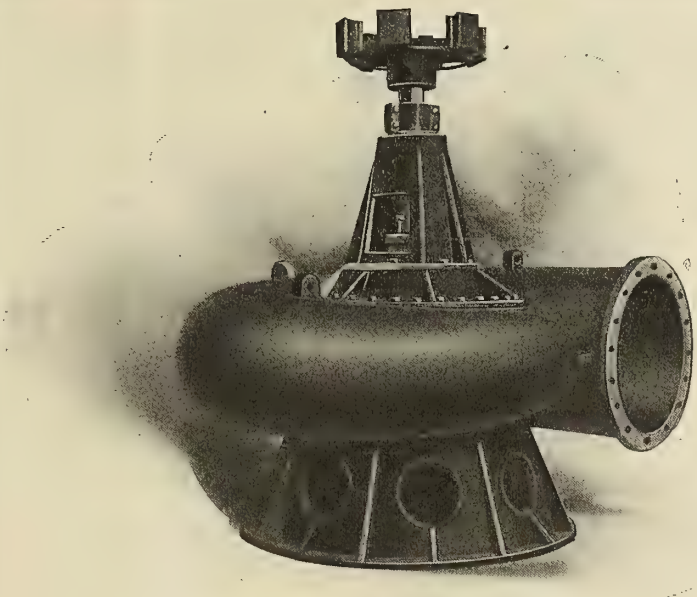
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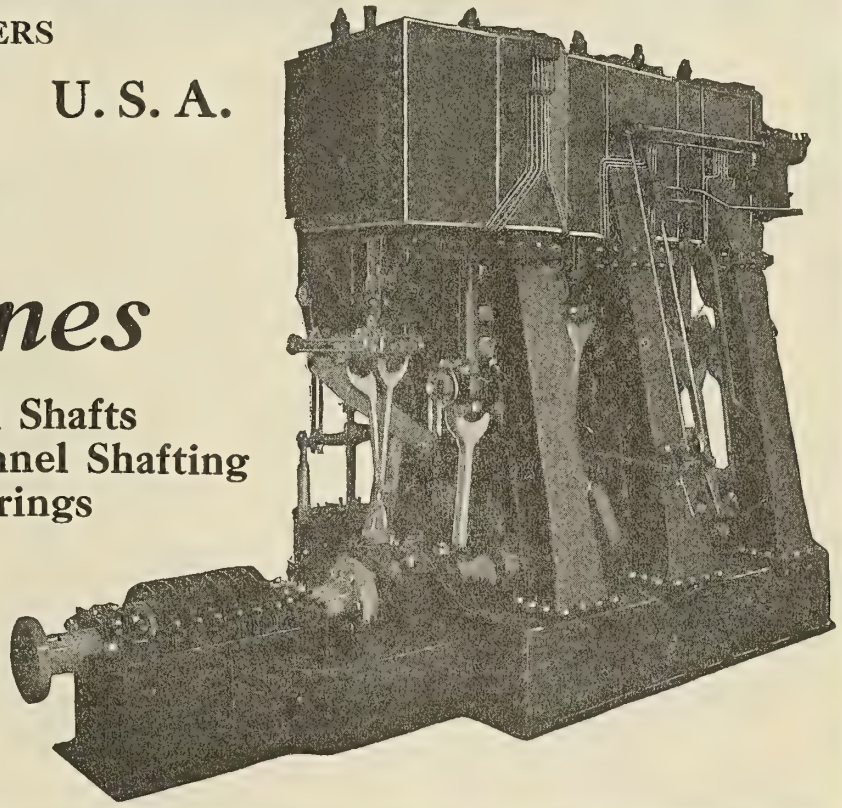
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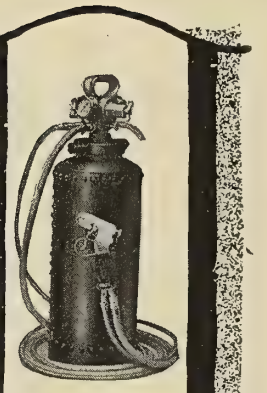
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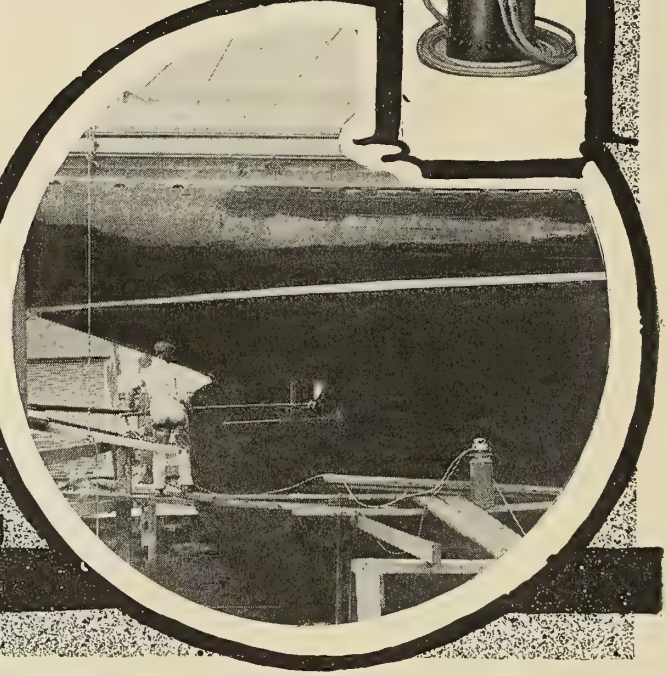
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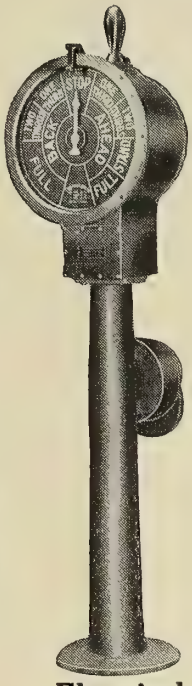
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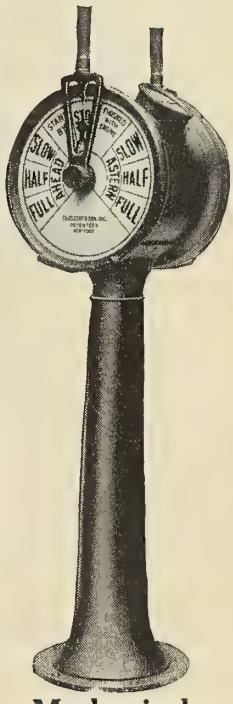
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Worthington Pump & Machinery Corporation, 115 Broadway, New York

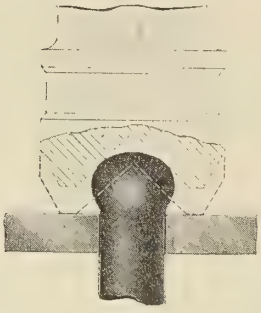
SCALES—ALL KINDS
Fairbanks, Morse & Company, Chicago, Ill.

SCARPHING MACHINES
Skinner & Eddy Corporation, Seattle, Wash.

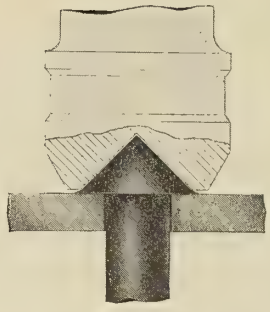
SCREW CUTTING TOOLS AND GAUGES
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This insures an absolutely tight rivet.
And the hole is filled at BOTH ENDS.



Both ends are tight on an American rivet. On the partly formed head the metal flows into the hole and over the sheet during driving.



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New York
Montreal

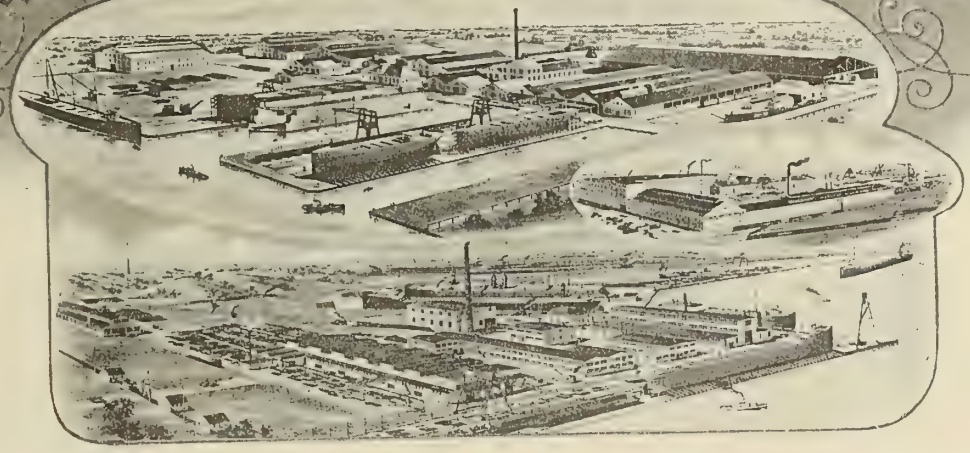
McCormick Bldg.
Chicago
Winnipeg

Union Bank Bldg.
Pittsburgh, Pa.
Cleveland

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SCREW PLATES
Morse Twist Drill & Machine Co., New Bedford, Mass.
Williams, Wm. E., 62 Front Street, New York
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Cleveland Punch & Shear Works Company, Cleveland, Ohio
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Crouse-Hinds Company, Syracuse, N. Y.
General Electric Company Schenectady, N. Y.
Engberg's Electric & Mechanical Works, St. Joseph, Mich.
Sperry Gyroscope Company, Brooklyn, N. Y.
Western Electric Company, 151 Fifth Avenue, New York
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(See Steel Shafting)
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(Hollow Seamless Steel)
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Hardie-Tynes Manufacturing Company, Birmingham, Ala.
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Morse Dry Dock & Repair Co., Brooklyn, N. Y.
National Tube Company, Frick Building, Pittsburgh, Pa.
Williams, Wm. E., 62 Front Street, New York
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(See Power Shears)
SHEARS
(See Power Shears)
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Atlantic Corporation, The, 77 Franklin Street, Boston, Mass.
Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.
Bethlehem Shipbuilding Corporation, Bethlehem, Pa.
Consolidated Shipbuilding Corporation, Morris Heights, New York
Cramp, Wm. & Sons, Ship & Engine Bldg. Co., Richmond & Norris Sts., Philadelphia, Pa.
Davis & Son, M. M., Inc., 366 Fifth Avenue, New York
Fletcher, W. & A., Company, Hoboken, N. J.
Foundation Company, The, 233 Broadway, New York
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Howard Shipyards & Dock Co., Jeffersonville, Ind.
Imperial Shipbuilding Corporation, Detroit, Mich.
Johnson Iron Works, Ltd., New Orleans, La.
McDougall-Duluth Company, Duluth, Minn.
Manitowoc Shipbuilding Company, Manitowoc, Wis.
Merchant Shipbuilding Corp., Chester, Pa.
Morse Dry Dock & Repair Co., Brooklyn, N. Y.
Newburgh Shipyards, Inc., Newburgh, N. Y.
Newport News Shipbuilding & Dry Dock Co., Newport News, Va.
New London Ship & Engine Company, Groton, Conn.
Northwest Engineering Works, Green Bay, Wis.
Peninsula Shipbuilding Company, Portland, Oregon.
Saginaw Shipbuilding Company, Saginaw, Mich.
Skinner & Eddy Corporation, Seattle, Wash.
Standard Motor Construction Co., 120 Pine Street, Jersey City, N. J.
Todd Shipyards Corporation, 15 Whitehall Street, New York
Union Dry Dock & Repair Company, Weehawken, N. J.
Valk & Murdoch Co., Charleston, S. C.
Vulcan Iron Works, Inc., Foot of Morris St., Jersey City, N. J.
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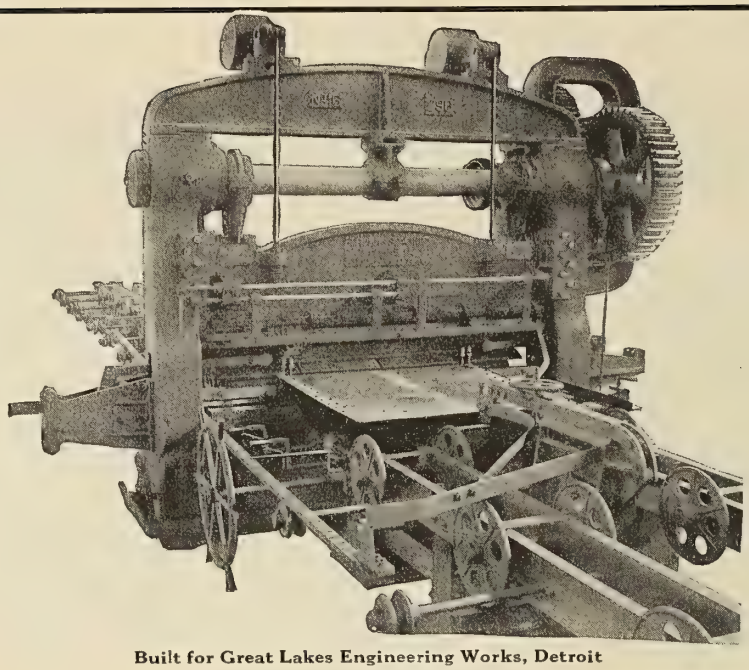
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Smooth-On Manufacturing Company, 570 Communipaw Ave., Jersey City, N. J.

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(See Adjustable Sprocket Rims)

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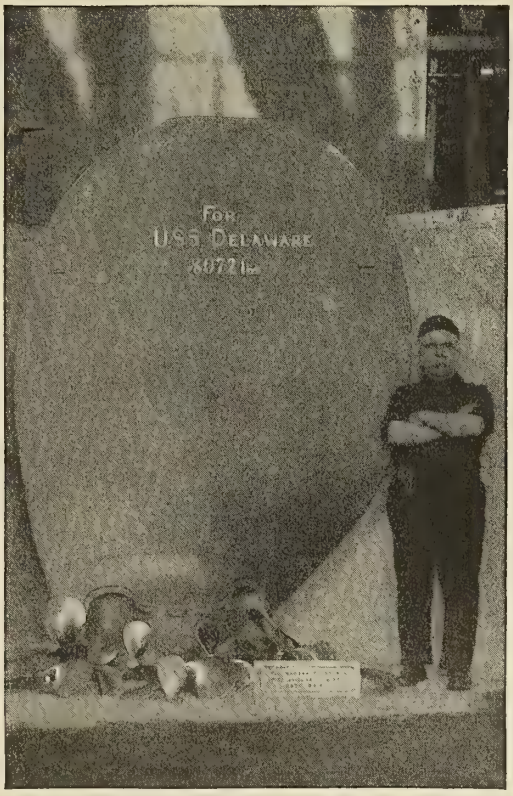
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American Flexible Bolt Company, Union Bank Bldg., Pittsburgh, Pa.

STAYBOLT IRON
Harvey, Arthur C., Company, 374 Congress Street, Boston, Mass.

STAYBOLT TAPS
(See Taps & Dies)

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(See Engines)

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Niles-Bement-Pond Company, 111 Broadway, New York

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General Electric Company, Schenectady, N. Y.
Hallidie Company, Spokane, Wash.
Howden, James & Company, Wellsville, N. Y.
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Steam Motors Company, Springfield, Mass.
Terry Steam Turbine Company, Hartford, Conn.
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National Tube Company, Frick Building, Pittsburgh, Pa.

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Great Lakes Engineering Works, Detroit, Mich.
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In olden days Thor was popularly supposed to be the God of Thunder. He wore a red beard, and was girded with a belt of great strength; in his hand he swung a mighty hammer with which he subdued the Frost Giants in the Springtime. His chariot was drawn by two goats from whose hoofs and teeth sparks of fire flashed. Many victories over the Giants are credited to Thor. Our ancestors believed that the thunder was the roll of his chariot wheels; the wind, his onward rush; the striking of his hammer, the lightning.

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Kerr Machinery Corporation, Kerr Building, Detroit, Mich.
Lidgerwood Manufacturing Company, 96 Liberty Street, New York
McNab Company, The, Bridgeport, Conn.
Maine Electric Co., Portland, Me.
Mundy Hoisting Engine Company, J. S., Newark, N. J.
National Hoisting Engine Company, Harrison, N. J.

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American Clay Machinery Company, Liberty Building, Philadelphia, Pa.
American Engineering Company, Philadelphia, Pa.
Dake Engine Company, Grand Haven, Mich.
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Hyde Windlass Company, Bath, Maine
McNab Company, The, Bridgeport, Conn.

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(See Ranges)

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(See Rolls)

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(See Marine Superheaters)

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Pease Company, C. F., 230 Institute Place, Chicago, Ill.

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(See Electric Tachometers)

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Stevens-Aylsworth Co., Inc., 253 Broadway, New York
Wayne Oil Tank & Pump Co., 589 Canal Street, Fort Wayne, Ind.

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Wayne Oil Tank & Pump Company, 589 Canal Street, Fort Wayne, Ind.

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Merchant Shipbuilding Corp., Chester, Pa.
Newport News Shipbuilding & Drydock Company, Newport News, Va.

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Stevens-Aylsworth Co., Inc., 253 Broadway, New York

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Pratt & Whitney Co., 111 Broadway, New York
Standard Tool Company, Cleveland, Ohio
Whitman & Barnes Manufacturing Company, Akron, Ohio
Williams, Wm. E., 62 Front Street, New York

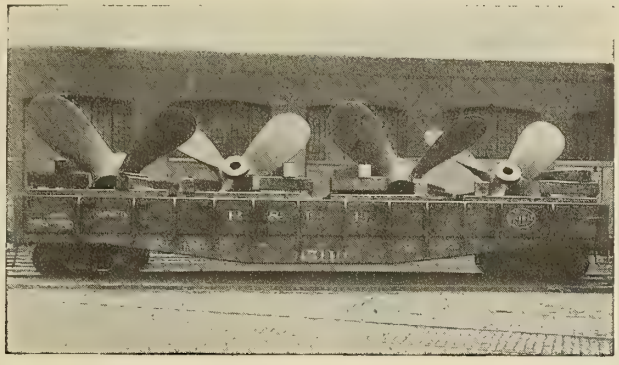
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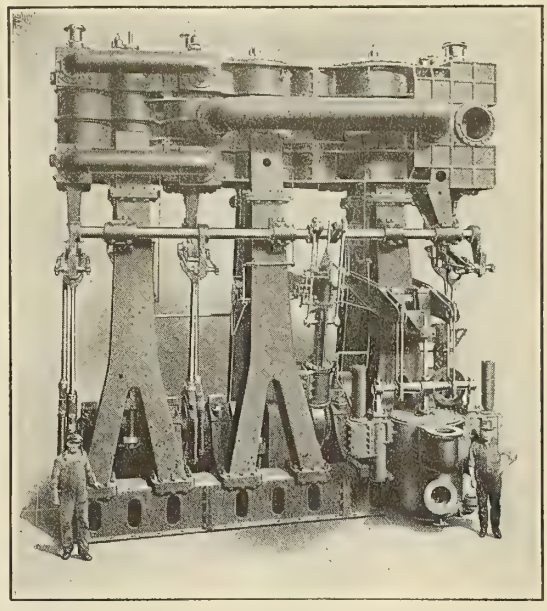
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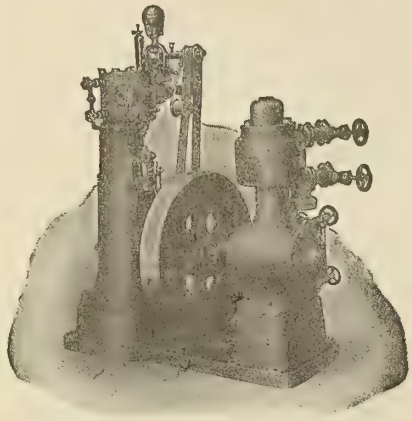
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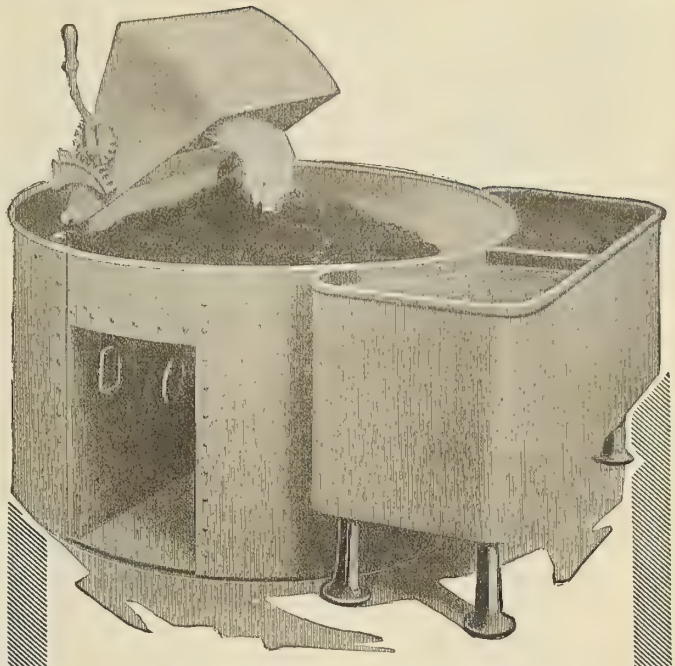
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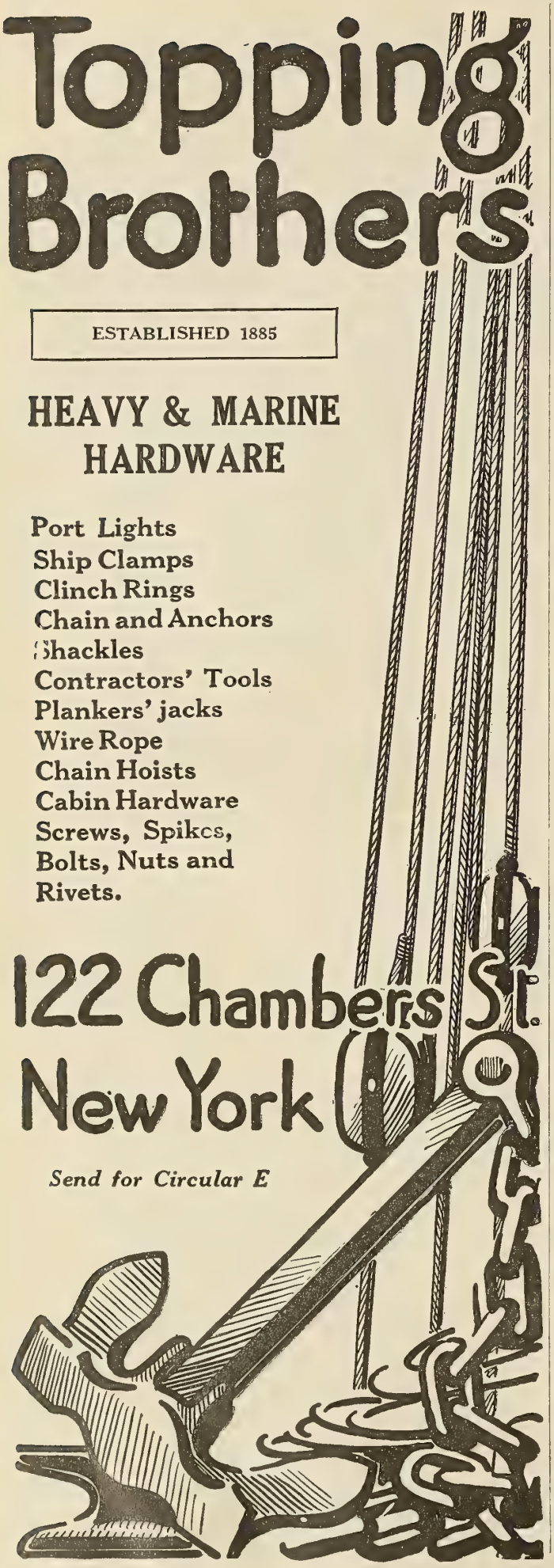
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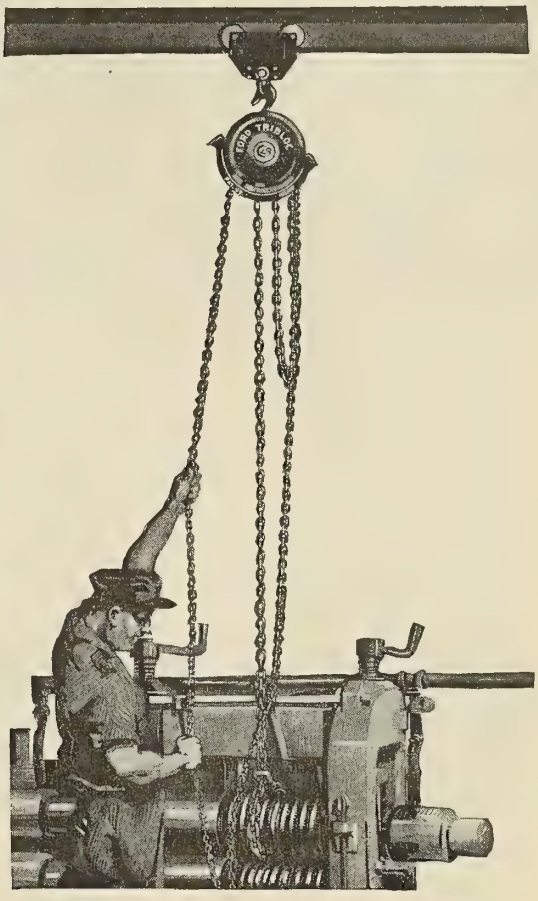
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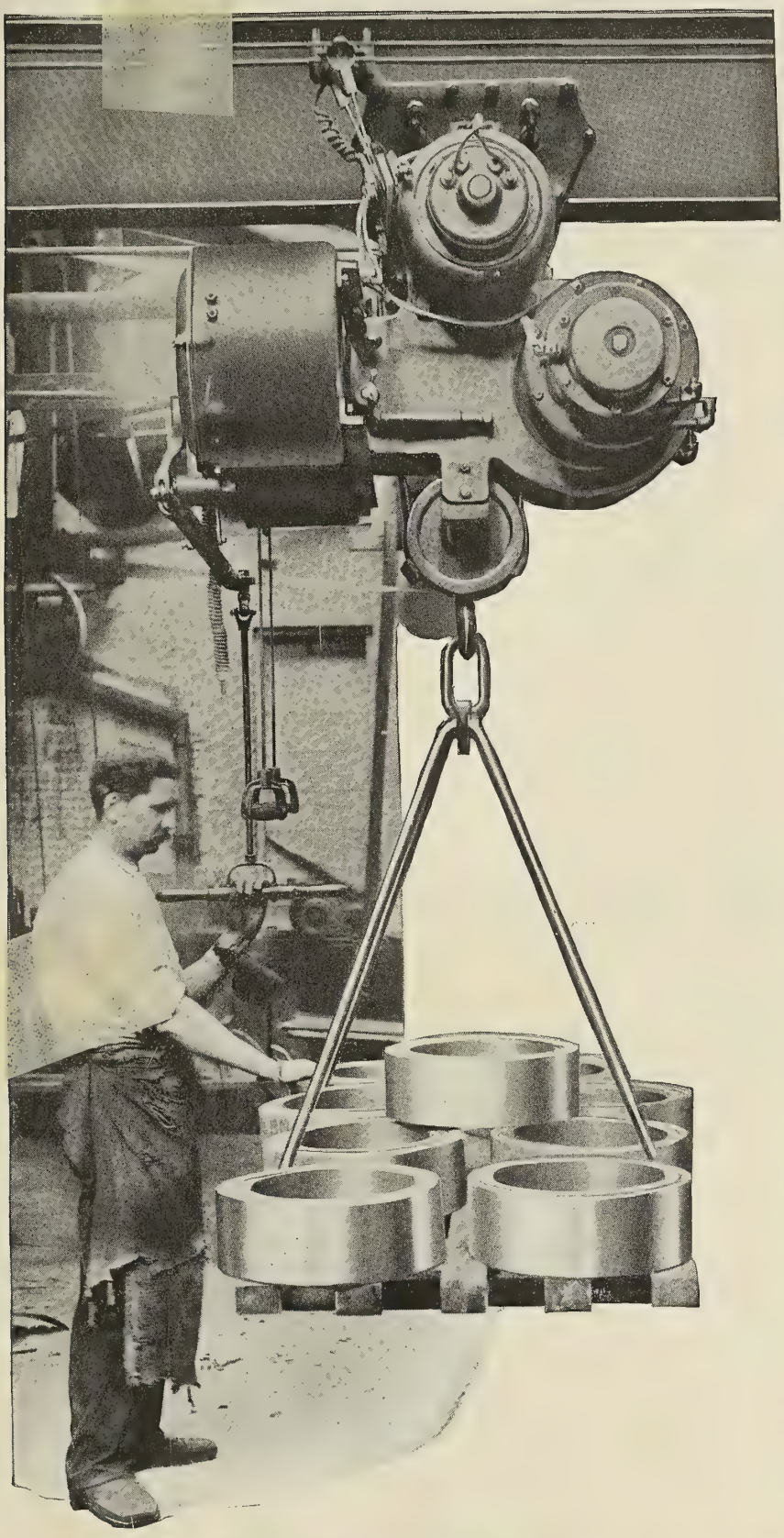
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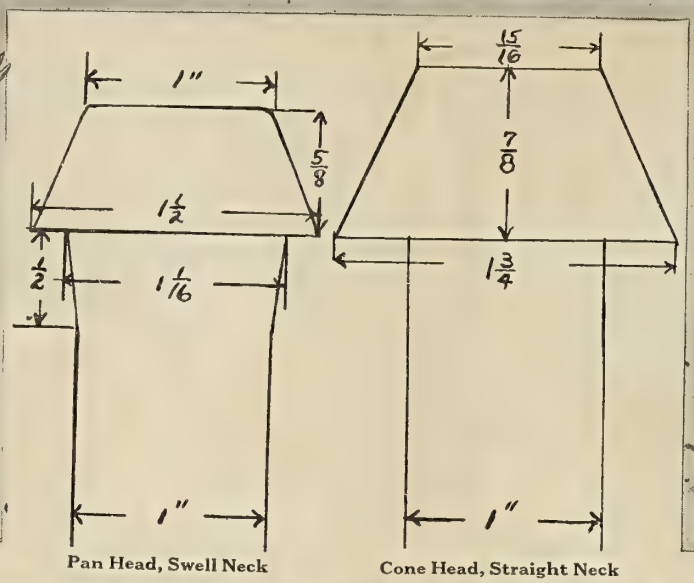
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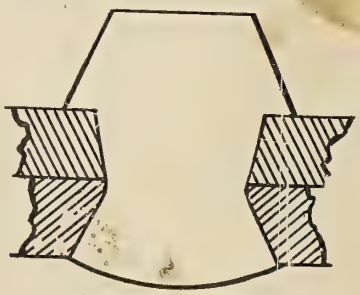
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